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COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC.

Vol. XXI APRIL, 1916 No. 4

MORNINGSIDE PARK FROM 110TH STREET.

THE PUMPING PROBLEM IN MORNINGSIDE PARK

BY FRANK RICHARDS.

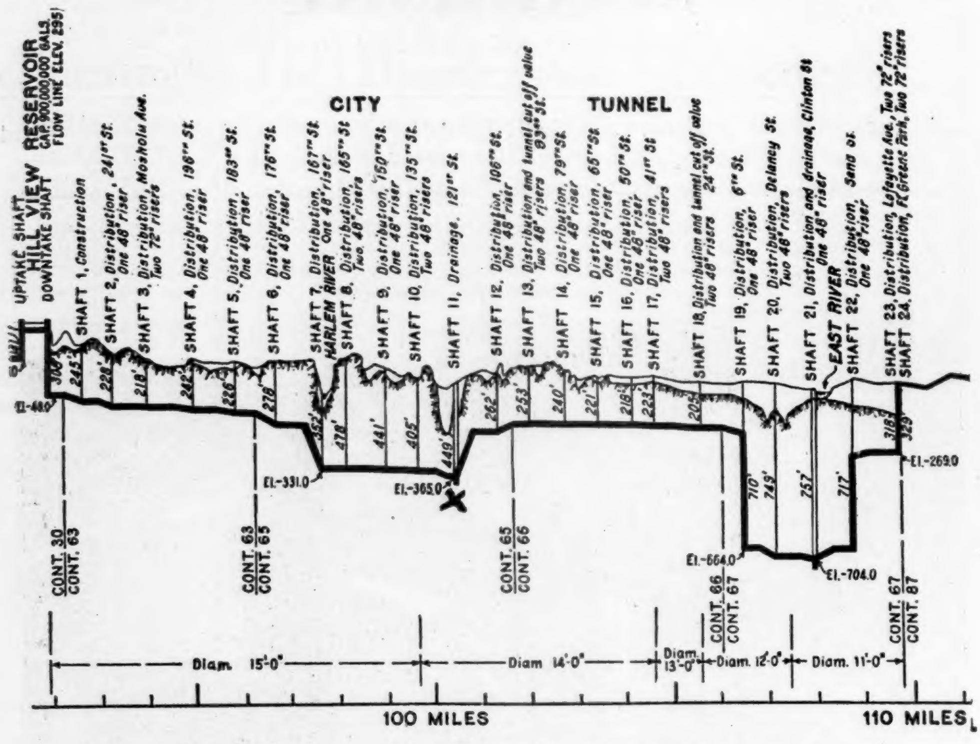
An interesting discussion is in progress in connection with the unwatering equipment now being installed in Morningside Park, New York City, by the engineers of the Catskill aqueduct. It is imperative that when the aqueduct has been filled with water and submitted to full service pressure there shall be ready means for rapidly unwatering it, at least for inspection, and also to provide an opportunity for making such repairs as may appear to be necessary. The plant must also be a permanent one to be ready for any emergencies later.

It is also practically imperative that the unwatering plant shall be located at the precise point selected, because here is located the shaft (No. 11) which connects with the lowest point of the city aqueduct in the 14 miles from Hill View Reservoir to the much deeper siphon by which the aqueduct passes under the East River, which will be unwatered by another installation at Clinton Street. To be quite correct, the portion to be unwatered by

the plant here spoken of extends only down to 93rd Street a distance of about 10 miles, and the total volume of water to be lifted at each unwatering, will be a little over 70,000,000 gallons.

The excellent plan adopted by the engineers of the aqueduct of locating the construction shafts, wherever possible, in the parks of the city, or in such locations as to least interfere with the traffic and life of the city, has been universally commended, and the commendation applies to the location of shaft No. 11 in Morningside Park as well as to the others. When, however, this shaft is to be used also for unwatering the aqueduct whenever necessary, this necessitating the erection of a large, unsightly and incongruous structure in an attractive and frequented portion of the park, we must concede that there has been a deplorable error of judgment. As this shaft is not immediately over the line of the aqueduct, but is connected with it by a lateral tunnel, it is evident that it might have been located outside of the park anywhere in the vicinity, and where a suitable building might have been entirely admirable and appropriate.

However, the conditions being as they are, it is necessary to make the best of them, which leads to the considering of the essential mechanical features of the plant which is being installed. The principle adopted is admirable for its simplicity, and it is no wonder that engineers express their approval of it. The unwatering operation may be briefly described as follows:



PROFILE OF N. Y. CITY TUNNEL, PUMP IN PARK AT X.

At the beginning of the unwatering, the shaft being full, or nearly full of water, there is floating upon the surface of the water, of course partially submerged, a hollow steel cylinder closed at the bottom, nearly 13 feet in diameter and more than 20 feet high. Within this floating cylinder there are powerful four stage centrifugal pumps and electric motors for driving them. The water enters the pumps by passages in the bottom or side of the float, and, as the submergence of the float is practically constant, no matter

how much the water in the shaft may be lowered, there is no change in the pump intake or suction conditions until the unwatering is completed. The water delivered by the pumps is carried up a vertical pipe and discharged into a sewer. That is all; and how could anything be simpler, or why should not engineers admire and endorse it?

It may be added that this device is not new, and is not in any way experimental. It has been used for unwatering mines and is also satisfactorily employed at other points on the Catskill aqueduct system. It is scarcely justifiable, however, to assert that this is the only device that could be used at shaft No. 11, and it is even a debatable question whether it is in fact the best device that could be selected.

Looking now a little at the details of the unwatering operation as sketched above, it is to be remembered that when the unwatering is ordered the first thing to be done is to lift the float, to move it laterally until it is directly over the shaft, and then to lower it down into the shaft until it floats upon the water—and it weighs 40 tons.

This partially accounts for the height of the house, for the heavy steel framing of the building, and for the powerful hoisting apparatus required to be installed. The vertical water discharge pipe will then have to be hoisted and secured in place, length by length as the pumping proceeds, until at last there will be nearly 500 feet of it. Any one can easily imagine what will be the weight of a single length of this pipe 20 feet long, 10 inches in diameter and strong enough to safely stand a head of 450 feet of water, and also what will be the aggregate weight of the entire discharge pipe.

The pipe, by the way, must be carried to a height 30 or 40 feet above the required delivery level, and all the water must be pumped that additional and otherwise unnecessary height on account of the telescoping arrangement for the continuity of the discharge pipe as the float descends through the intervals between the successive additions of the 20 ft. lengths. When each additional length of pipe is to be inserted the pump must be stopped for a time sufficient to make the connection.

MORNINGSIDE PARK—STAIRWAY AT 116TH STREET.

After the unwatering is completed the discharge pipe must be disconnected and hoisted piece by piece and laid away until the next unwatering, and the cumbrous float also must be hoisted and moved to the side, all of which work is chargeable to each single unwatering.

For the completion of the comparison purposed to be made it is proper to insert here

the enumeration of the supplementary apparatus contained in the pump house as furnished by the engineers of the aqueduct.

"In the chamber at the top of the shaft is a large reel for the electric cables conveying the power and light current to the float, electric transformers, switchboard, and other electric apparatus for hoisting the discharge pipe sections, a hoist for operating the elevator which carries the operatives and supplies from the chamber to the float, duplicates for certain parts of the equipment and miscellaneous appurtenances."

The imperative necessity for the building in Morningside Park, for the area and the height of it, and also for its location in the precise spot selected, is sufficiently evident if the float pumping system is employed. It is under the circumstances certainly proper to consider the claims of other devices which are without the one, in this case, highly objectionable feature. Only the claims of the Air Lift will here be presented, and they would be deserving of consideration in any case, since the air lift is now frequently selected in open competition with all the known devices for pumping water all over the country and to suit a great range and variety of conditions.

A simple air lift consists of a vertical water discharge pipe extending down into the water a considerable distance below the lowest level to which the water is to be pumped, and a parallel pipe of much smaller diameter for conveying the compressed air to the lower open end of the water pipe. This air pipe may be within the water pipe or at the side of it. The water pipe is without valves or operating parts, or anything requiring manipulation of any kind, and for the air pipe there is only a valve for turning on the compressed air or shutting it off, or in some cases for partially closing the pipe to control the actual quantity of air used, as it may be required. The valve on the air pipe may be located anywhere along the line of it, so that there is no possible excuse for anything pertaining to an air lift above the level of the point of discharge.

The compressors for supplying the air for the lift may of course be located within any reasonable distance, say a mile in this case, and they require no comment here. They would presumably be two-stage machines with electric motors.

To speak more specifically: for the unwatering of the aqueduct at shaft No. 11, it would be advisable to install in the shaft two or possibly three air lifts which would be duplicates of each other, so that we here need consider only one of them.

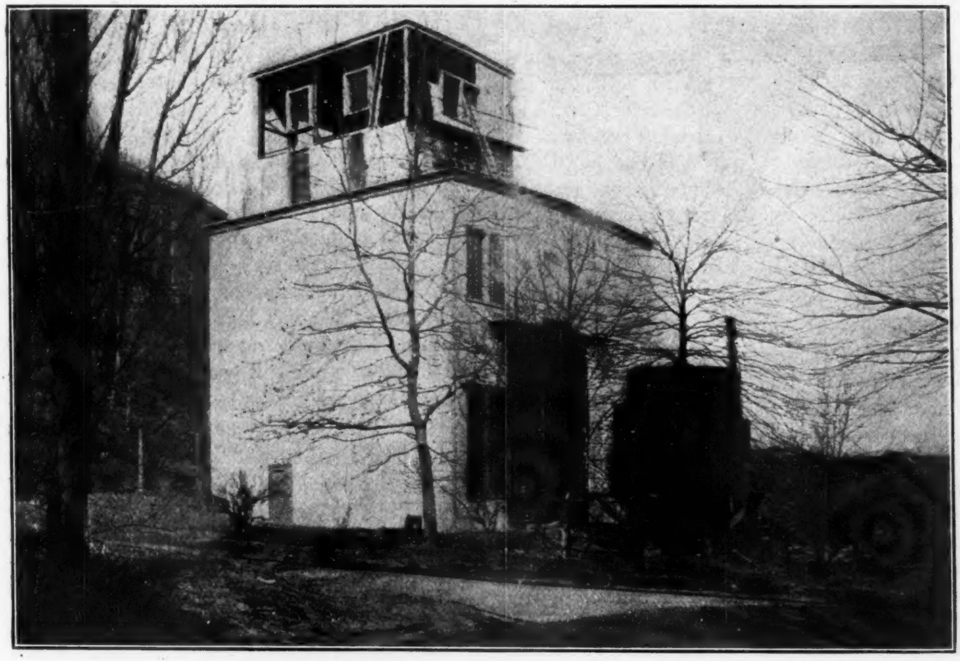
To provide the necessary submergence for the discharge pipe, which would be say 12 in. in diameter, it would be necessary to bore a hole or supplementary shaft not over 18 in. in diameter down into the solid rock to a depth of say 200 ft. below the present bottom of the shaft. In the present state of the art, and with the special drills now provided for this purpose, this would be a simple matter, and this would be the only requirement in preparation for the air lift installation.

It is assumed that the water in the shaft, and all the water in this section of the aqueduct which is above the sewer level has been allowed to flow off by gravity, and the air lift operation now commences. The water level may be 20 ft. below the surface of the park and the floor of the building which has been erected here. We have now a 12 in. water discharge pipe in the shaft, supported and held in position by any suitable means, the upper end a little above the sewer level, so that the water as delivered will flow off freely, and the lower end a sufficient distance from the bottom of the submergence hole to permit the aqueduct water at all times to flow in freely to the full capacity of the pipe.

About 250 ft. below the top of the discharge pipe a side opening, as for instance a tee, will be provided to which will be attached a compressed air pipe delivering air at a pressure something less than 125 lbs. per sq. in. or sufficient to overcome the pressure of the 250 ft. of water above it. Means should be provided in the discharge pipe for distributing the air all through the water in bubbles as small as possible instead of in unbroken masses. These bubbles rise and spread up through the water, with the inevitable result that the column of mixed air and water in the discharge pipe will be specifically lighter than the solid water outside the pipe, and the latter therefore will tend to drive the former up the pipe to preserve the balance. As the mixture of air and water

thus rises and overflows the top of the pipe it will be successively replaced by solid water flowing in from below to be in its turn aerated and driven upward, and that is the air lift in full operation. After the air is discharged into the water it has no more effect as to lifting the water by pressure and the subsequent movement of the column is due entirely to gravity. The operation of aeration, levitation and forced ascent of the column will continue uninterruptedly as long as the supply of air at sufficient pressure is maintained and the water supply is not exhausted.

The pressure required for the air will always be automatically determined by the height of the solid water above the point at which the air enters the discharge pipe, this height being called the air lift submergence. As the air lifting is continued, and the surface of the body of unaerated water is lowered, the pressure required to force the air down into the water will be reduced correspondingly. When the water level outside the discharge pipe is lowered to a point say about 50 ft. above the air connection the air pressure will be about 25 lbs., and it will be proper to shut off the air at this point and to open the valve in another compressed air pipe similarly connected to the water discharge pipe, but say 200 ft. lower, at the bottom of the main shaft or near the top of the supplementary submergence shaft. The air pressure required here will be again more than 100 lb., on account of the relatively greater height of the surrounding solid water. As this air is turned on the air lifting is resumed again and may be continued as before until the water level is brought down again to say 50 ft. above the air connection. If now the air is shut off from the discharge pipe at this point, and the valve is opened in a third air pipe which will deliver the air into the water pipe at the lower end of it, down at the bottom of the submergence shaft, this will lift the remaining body of water in the system and bring the water level down to the bottom of the shaft, thus completing the job of unwatering.

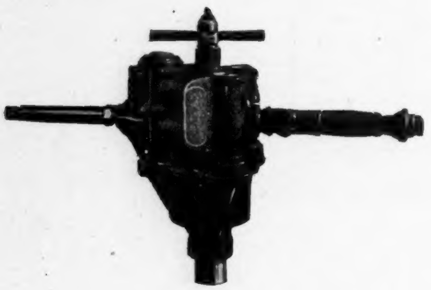


PUMP HOUSE IN MORNINGSIDE PARK. PUMP FLOAT AT THE RIGHT.

The above is a brief sketch of the essential features of operation of the relay system of air lifting. It will be seen that it completely solves the problem before the engineers. The dimensions and details can be determined by those of practical experience in this special

line, and the capacity of the installation to be provided will be determined by the time allowed for the unwatering.

The centrifugal pump system is not of high efficiency, and that of the air lift is still lower, but the difference in operating cost so far as the power is concerned will be offset by the additional labor cost in the case of the floating pump scheme.



A BIG LITTLE DAVID

The "Little David" line of pneumatic drills, manufactured by the Ingersoll-Rand Company 11 Broadway, New York, has now an additional number, exceptionally powerful, compound geared, designated model No. 11, SE. This drill is reversible and is adapted to the heaviest flue rolling, drilling, reaming and tapping. It is particularly recommended by the manufacturer for tapping on flexible stay bolt work, running-in stay bolt sleeves, for locomotive valve setting, and kindred heavy duty operations. It is so constructed that it develops full power on the reverse as well as the forward motion. This is pointed out to be of particular advantage, in that, after running a flexible stay bolt sleeve up tight, the No. 11 SE, due to its unusual power on the reverse motion, will also unscrew the sleeve cap. This obviates the necessity for the usual cumbersome wrench. In setting locomotive valves this new "Little David" tool has the same advantage, in that it will rotate the drivers in either direction facilitating the valve setting operation

This drill has the one piece, gear timed valves and ball and roller bearing crank shaft and connecting rods, and general simplicity of construction which have been features of the pneumatic drills of this manufacturer. The drill is ordinarily furnished with a No. 5 Morse taper socket. It operates at a normal spindle speed of 100 r.p.m.

WAR DESTROYS QUARRIES

One feature of the great European war in its relation to the stone trade we have not seen touched upon. Much of the severe fighting in Belgium and France has been in the quarrying districts. It was reported early in the contest that some of the great quarries had been utilized as cannon pits and as shelters for the soldiers. During the recent terrible struggle in the Verdun sector the French took refuge in a deep cave at the rear of a quarry at Louvemont, and the Germans made repeated efforts to dislodge them. During all of this fighting there has been a continual rain of shells loaded with the most powerful explosives known. During the first week of the fighting at Verdun it is stated that the Germans fired no less than 3,000,000 shells. Eye-witnesses tell of the terrible havoc wrought by these shells, as well as by the mines that are continually exploded. Vast craters are blown out of the rock and soil, and fortresses of steel and concrete are crumbled into fragments. Every stone man is aware of the fact that a single careless explosion of dynamite may ruin an entire deposit of valuable stone. It would seem, therefore, that this ceaseless hail of shells must have shattered all the ledges of stone within their radius so that there can be no possible utilization of the material in the future for building or decorative purposes. Of course, all of this is of small consequence in comparison with the terrible loss of life, and yet it serves to illustrate the awful waste of war.—*Stone.*

DRYING FILMS FOR THE MOVIES

The drying of photographic films by the ordinary method is a slow process and is the cause of much delay in the manufacture of the long strips required for moving pictures. To reduce the time of production one of the big film companies has introduced a special apparatus that greatly facilitates the process. The wet films are wound spirally on large drums 27 feet in diameter, which are introduced into a casing that has a 3,000-watt air heater set in the back. The current is turned on, and the drum is steadily revolved by a small electric motor, with the result that the film is now thoroughly dried in about one-fourth the time previously required, which varied from 4 to 10 hours according to the humidity of the atmosphere.

CO-OPERATION OF AMERICAN ENGINEERS WITH THE UNITED STATES GOVERNMENT

The following is from the address of President W. L. Saunders of the American Institute of Mining Engineers at the annual meeting, New York, Feb. 15, 1916.

During recent months there has been a marked change in the relations of the Institute to its fellow societies and to the Government of the United States. That change is in the direction of co-operation. The Secretary of the Navy has appointed two of your members to the Naval Consulting Board to co-operate with members of ten other scientific organizations. This board is now organized, and through its work your Institute is brought into close touch with the activities of the other societies and with the United States Navy.

The President of the United States has requested us to recommend to the Government one of our representatives in each State in the Union to act in collaboration with a member in each State from the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Chemical Society, thus organizing a directorate of engineers for each State, which will conduct, through the members of each of the five societies referred to, living in each State, a campaign of industrial preparedness.

No more important step than this, it seems to me, has been made in the history of your Institute. The work which these forty-eight boards are expected to do will be directed by a committee of the Naval Consulting Board, and the far-reaching effect and usefulness of this work can hardly be over-estimated. We hear a great deal about preparedness. Many plans have been suggested for increases in the army and navy of the United States and much difference of opinion exists on the subject. As far as I have observed, there is no difference of opinion on the question of industrial preparedness, which means a co-ordination and co-operation with the Government of our mines, mills, works, and factories, so that in the event of trouble they may be in a position to respond promptly, energetically, and with full force, to the needs of the nation.

Even as a peace measure such an organization is desirable. This country is the largest nation in the world industrially, yet our industries are working more or less at cross purposes, are not in touch with each other or with the Government. Such contact as has existed in the past between business and Government is a special, not a general, contact. Certain industries have had the ear of the Government, while others have not. Nor is the Government at present in a position to feel the pulse of the great industrial strength of the United States in peace or war. In this and in many other ways a general contact will not only be beneficial to the Government but should prove of wholesome advantage to our American industries.

The engineer has been called upon to take this important step. Who is better fitted to do it and do it well? Mind you, it is not the mining engineer alone, but the civil, the mechanical, the electrical and the chemical engineers, co-operating as a unit. We have heard a great deal about the desirability of co-operation among engineers, but so far it has been mainly academic. Here we have a practical fulfillment of our desires and an opportunity the importance of which can scarcely be measured. It is no less important to the engineer and to the whole profession he represents than it is to the industrial strength and prosperity of the nation.

The engineer is essentially a man of action, an executive, an administrator, not a mere scientific worker, operating behind closed doors in a dusty laboratory or over a drawing board. His place is out in the middle of the road, with his coat off, leading men, and initiating and directing measures of usefulness to the whole people. We have heard our profession defined as one which uncovers the hidden forces of Nature and puts them at the service of mankind. We have done a good deal in the line of uncovering these hidden forces, but have been very slow in our activities in placing the things revealed in useful operation. Modesty is not only a characteristic but a fault among engineers.

Some consider it undignified to get what they call notoriety, but it seems to me that there is a difference between notoriety and reputation; the way to get reputation is to do things, not under a bushel, but in the light so that the world may know and the full measure of benefit may be derived by inspiring public confidence not alone in what has been achieved, but in the personality of the in-

dividual who is responsible for the achievement.

Your Institute, like other long established scientific bodies, has an integrity beyond reproach. It does not work for money but for scientific advancement. Let its usefulness be extended to broader fields and let us resolve to make this organization, which has now been called for by the President of the United States, a useful and permanent force in our whole national life.

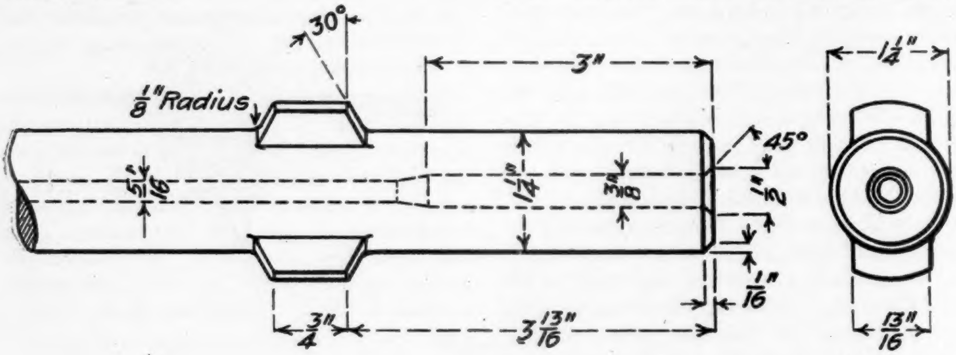


FIG. I. DRILL SHANK ON ROUND STEEL.

DRILL SHANKS AND BITS

By P. B. McDonald

The matter of drill-steel shanks is not clearly understood by many mine-superintendents, particularly as applying to steel for the increasingly popular mounted hammer-drill type of drills. Obviously it is not possible to use the same sort of chuck with a hammer-drill as is employed in a piston-drill, because the pounding by the hammer on a steel that is rigidly held would only waste the effort. The so-called 'standard Leyner drill-steel' is 1¼ or 1⅛-inch round steel; each drill-steel has two lugs on its shank, as shown in Fig. 1. These lugs, when the steel is shoved into the drill-chuck and given a fractional turn, serve to hold the steel in the chuck, both to facilitate rotation and in order that, if the steel gets stuck in the hole, the cranking back of the machine will extricate the drill. But some superintendents do not like these lugs, which, they say, are difficult for the blacksmith to make. To avoid the use of lugs on drill-steel for a mounted hammer-drill, hexagon drill-steel can be employed to insure rotation, as with stoper or sinker drills; this, however, necessitates a chuck somewhat different from the regular Leyner type. If the steel gets jammed in the hole, it is pulled out with a wrench; a sinker-drill, like the 'Jackhamer,' has a special 'puller' attached to it, being an ostentatious feature of that machine.

Drill-steel without lugs is likely to get pushed too far into the machine, injuring the efficiency by shortening the stroke of the hammer. To obviate this a collar is made on the steel, as shown in Fig. 2. This limits the distance that a steel can be pushed into the machine. However, one of the best methods is to use a tappet or anvil-block between the steel and the hammer of the machine; an additional advantage is that the anvil-block saves the hammer from becoming battered against the drill-steel.

E. M. Weston, in discussing South African drilling practice in the *Mining Magazine,* stated that "the whole theory of the design of rock drill bits as formerly expounded is wrong. The point most insisted on has been the necessity for allowing ample clearance between the wings of the bit for the ejection of cuttings." That is why the four-point cross-bit has been the standard for so long. It is now being demonstrated that the four-point cross-bit is by no means so efficient as more blunt bits properly designed to drill a rounder and more even hole while holding their gauge to better advantage. Hollow steel, as now used with hammer-drills, effects satisfactory removal of the rock chippings or mud by forcing water or air against the bottom of the hole. As Mr. Weston points out, "the more we make the bit into the shape of a piston with small openings for the escape of water and cuttings, the more violent will be the ejection of cuttings, which are thus not pounded up at all, greatly increasing the drilling speed," and again, "it

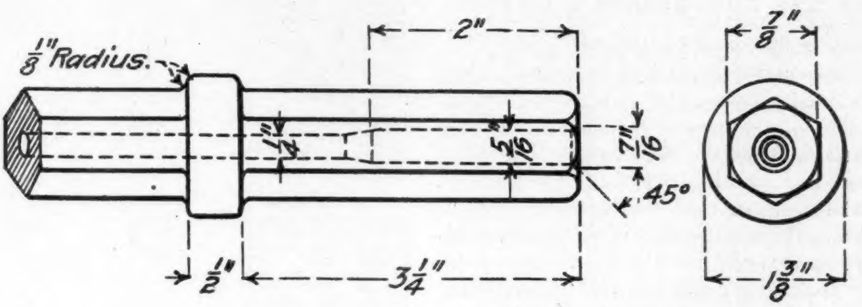


FIG. 2. COLLARED HEXAGON STEEL.

is quite feasible to use 1¼-in. steel with a hollow core of ½-in. diameter, or 1⅛-steel with ⅜-in. hollow core, such that the rock in the centre of the hole would be drilled around to form a core and broken off in large pieces, reducing the cutting necessary."

It does not require much perspicacity to see that the ordinary four-point cross-bit with its comparatively fragile edges soon dulls and wears away. This is where the new blunt-looking bits, such as the H and Carr, show to advantage. They hold their gauge much better than a cross-bit while drilling as fast or faster. The special feature of the design of the H-bit is its two parallel cutting edges, as compared to the one edge of the Carr bit. In the course of trials at the Gastineau mine, near Juneau, Alaska, two mounted water-hammer drills secured to a single cross-bar were tried with an H-bit of the International High Speed Steel Co. in competition with an ordinary cross-bit. The results showed a small advantage in the actual speed of drilling of the H-bit over the cross-bit, and a much greater advantage in not fitchering in bad ground. Furthermore the blunt and dull-looking H-bit did not require sharpening nearly so often, one set of steel out-drilling and out-lasting two sets of the cross-pointed steel. Variations of the chisel types of bits have their advocates, on account of the room allowed for the escape of mud. In reality the Carr bit is of the blunt-chisel variety, while the H-bit may be called a double-chisel type. However, while the simple chisel-bit may be effective in some rocks with hammer-drills, it has definite limitations particularly with piston-drills. That the introduction of improved drill-bits is a matter of no small consequence is indicated by a statement by James MacNaughton, general manager for

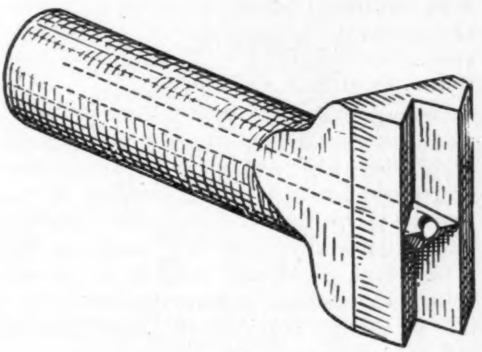


FIG. 3. H. BIT.

the Calumet & Hecla Co.; he said, "the use of the one-man drill and Carr bit resulted in an increased out-put per miner equivalent to his total production of a few years ago."

Regarding the so-called flat cross-bit—or low-centre cross-bit, which soon wears to the same shape—that is, with edges slightly flattened in proportion to the distance from the centre, it is clear that the additional metal in the wings makes reinforced edges that stand up to the work in hand, giving a stronger and more resistant bit than the ordinary cross-bit, because holding its gauge much longer. The whole idea is to get a bit that will not wear on the edges as quickly as the cross-bit; any method of reinforcing the peripheral edges, while not impairing the cutting speed or impeding the ejection of cuttings, is salutary, and represents the goal as at present recognized.—*Mining Press, San Francisco.*

Pennsylvania leads all other states in the country in the use of steam power, using twenty per cent. of all that is used in the entire United States.

GIVE THE COMPRESSOR A CHANCE

By Harry E. Scott.*

We hear many complaints about the inefficiency of air compressors, no matter how large or how small the mine or the compressor. This is not surprising when you take into consideration the fact that in many places the compressor while running only 6 drills has to supply enough air for 10, because of the loss by leaks in pipes and hose.

The leak being small, it is not believed that the loss is serious, so it is disregarded for a few days until the hole is so large that it has to be repaired. This takes just as much time as it would in the beginning, and is only done after a loss of air that should have been used to run the drills.

The majority of the small companies install a compressor just large enough to do the work at that time, which is proper; but as the mine progresses and more work is crowded on the machine by the installation of other drills, the compressor is overloaded and cannot do the work. Then the trouble starts—first with the most proficient of all kickers, the drill runner, then up the line it goes to the proper official, and he in turn goes after the machinery company. But is it the fault of the compressor? The foregoing is only one of the many reasons for poor air and the so-called inefficiency which, when investigated, are usually not the fault of the compressor, but due to the conditions found in most mines.

In the following paragraphs I will enumerate some of the causes for air losses that I have found in the mines of the West and Southwest in the many long years I have followed the game. Some of these offenses I plead guilty to in the days before I got the efficiency bird on my perch.

A CASE OF CARBONIZATION

Several years ago I went to an isolated camp on the desert. There was a small compressor that had been run by about 30 men, as near as I could find out, in the 1½ years it had been in use. The blacksmith would start it in the morning, and when he became tired, his helper would take his place. If they both had other work to do, a miner, mucker or a machineman who was not feeling well enough to go underground was put on for a few days to rest up. During the busy season, when none of these was available, or when stockholders were visiting, the superintendent or foreman would take a chance at it. The compressor was large enough to run seven drills the size they were using and keep 100 lb. pressure without getting hot.

At the time I arrived on the scene only three drills were running, carrying 60 lb. of air. You could fry pork chops anywhere on the compressor or motor. Taking advantage of a shutdown the second day on the job, I examined the cylinders and valves. It was a miracle that the receiver and the machine itself had not gone heavenward in small pieces. It was carbonized wherever possible for it to be so and I had to cut one of the outlet valves loose with a chisel. After a shift's work with two helpers, cleaning, filing and scraping, the compressor was started the next morning, carrying 80 lb. of air. The second day 90 lb. pressure was carried and the third day 100 lb., every part of both the compressor and the motor running as cool as any small high-speed machine. This compressor had been the source of much trouble between the mining company and the makers for months. This stopped when it was cleaned and given a chance to do its work.

This is not the only windjammer I have met in this condition. I have seen many of them, especially the smaller ones, which do not usually get an even break. The compressor is installed properly and run two or three months, when the compressor man quits. Of course a new one is needed and the superintendent has an old friend or the foreman has a brother-in-law who left home and the plow a few months before. The plow and grindstone are the only machines he knows anything about. He has worked underground a few months, mucking and carrying steel for the machineman and is a full-fledged miner now. It is pretty hard on the young fellow, so he is taken out of the mine and put on the compressor with the injunction, "Keep plenty of oil on it and you will get along all right." He uses about three times the oil he should, and in a short time the cylinders are running pretty hot. It needs oil, he thinks, so in goes a double dose and down goes the efficiency. I do not say the young man should not have a chance, but he should have been broken-in properly.

At one place at which I was employed there was much argument between the master me-

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*Morenci, Ariz.

chanic's office and the mine department about the air. The mine men claimed they were not using as much air on the drills and air hoists as was being charged to them. I made some tests that surprised some of the bosses who had been letting the small leaks go. These drills and hose were taken out of the mine just as they were being used, with the same connections. On arrival at the shop the first test was made, and then repairs. After that a second test was made, and it showed where much of the disputed air, if not all of it, was going. These tests were made at 5,000 ft. altitude and one-minute runs.

	First Test			Second Test	
	Pressure, Lb.	Loss, Free Air, Cu.Ft. per Min.	Hose Repairs	Pressure, Lb.	Loss, Free Air, Cu.Ft. per Min.
	90	3.36	2 gaskets on connections	90	00
	95	105.29	2 gaskets on connections	90	6.95*
	90	42.00	2 small leaks	90	00
	85	38.75	1 small leak	90	00
			Air Drill Repairs		
Jackhamer	85	79.0	Cleaned and oiled.......	85	63.0
Stoper....	95	101.4	Cleaned and oiled.......	90	75.6
Piston....	90	182.0	Overhauled, leather.....	90	125.7

* This hose was full of small holes and could not be repaired, but by putting on two new rubber gaskets, over 98 cu.ft. of free air was saved each minute that the air was turned on, as it leaked just the same whether drill was running or not.

TESTS FOR LEAKS IN AIR CONNECTIONS.

These were not exceptional hose or drills, nor selected tests. They were the first we came to on entering the mine. The tests show enough air going to waste in the 4 hose to run 3 drills of the jackhamer type. If in fair condition, none of them need have been out of the stope more than 30 min. for repairs, but it seems to be the opinion of the modern shift bosses that it has to be "rock in the box" to pay dividends, regardless of how they get it. A drill or hose cannot lose time enough to be kept in condition; they do not consider the extra fuel at high cost which it takes to make this air that is doing nobody any good.

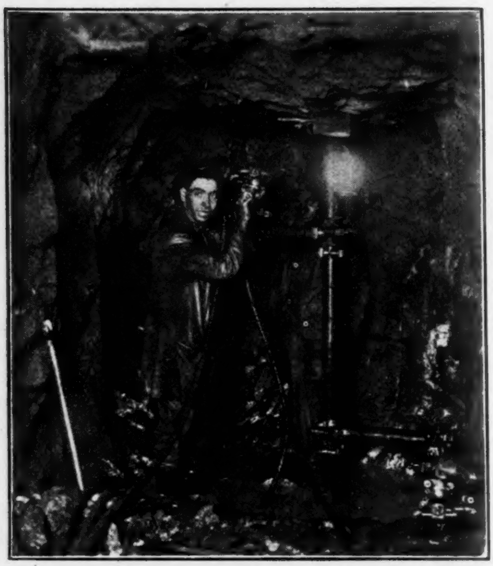
These things occur, not in one mine only, but in many of them—particularly the smaller ones, where the saving is more important than in the large dividend payer.

I do not believe that there is a superintendent who has enough fingers to count the leaks he sees or hears in the pipe lines on a single trip through a mine where a number of drills are working. The fault of the compressor and air drills is not with the makers so much as with the managers of the mine, who neglect the leaks in both the hose and the pipe lines and try to make a 10-drill compressor run 10 drills while throwing away enough air through leakage to run four more.—*Eng. and Min. Journal.*

SIMPLE PROCESS FOR PURIFYING MERCURY

Mercury which has been more or less long in service in a laboratory, gradually becomes contaminated by dust and dirt and amalgams of zinc, lead, copper, tin, etc., formed within it. It can be purified by a series of distillations in vacuum, which is a lengthy process, or by chemical methods (treatment with nitric acid), which takes still longer. We learn from *La Nature* that M. Margot, of Geneva has just perfected an old chemical process, which is both simple and effective. It consists in passing through the heated mercury a current of air which oxidizes the metals held in solution. The apparatus comprises an iron tube 1.6 meters long and 3 centimeters in diameter. This is held by two supports in a slightly inclined position. At the two extremities of the tube two tubular openings or necks are attached, one serving to admit air, the other to admit mercury. A Bunsen burner provides the heat required, which is from 150 to 160 deg. Cent. With this apparatus 10 kilogrammes of mercury can be purified in 24 hours. If a current of hot air is used the purification is said to be more complete.

What perhaps is the greatest pipe line in the United States is that running from the midway oil fields to Vernon, Cal., a distance of 153 miles of 8-inch steel pipe. The line has a daily capacity of more than 25,000 barrels.



SMALL DRILLS FOR A SMALL TUNNEL

By S. W. Symons.

One element of the new sewage-disposal system for Portchester, N. Y., is a tunnel 900 ft. long and 5x6 ft. in cross-section, in granite. In driving the tunnel, hand hammer drills were employed, mounted on the crossarms of a center column, as illustrated in Fig. 1. The drills were cleaned by water from the city mains. The advance averaged 200 ft. per month of 25 working days, the record month being 210.5 ft.

The contract for the tunnel was let to the Daly & Merritt Co., of Portchester. W. C. Brennan was Superintendent for the contractors and was responsible for the make-up of his organization and for the methods used in driving the tunnel. Borings were made along the line, and early in April, 1915, ground was broken with steam drills at the extreme southern point. The shaft was completed and the heading started on May 8, 1915, when the steam drills were discarded and mounted "Jackhamers" were substituted.

Air was furnished by a 12x12x16-in. Rand straight-line compressor taking steam from a 50-hp. portable Ames boiler. Steam pressure was 90 lb., the air pressure 80 lb. The air was led through a 1½-in. pipe a distance of 60 ft. to the shaft and thence to the heading. The capacity of the compressor was nearly double that required by the drills, with the result that it was run most of the time at only 88 r.p.m.—a little over half its rated speed.

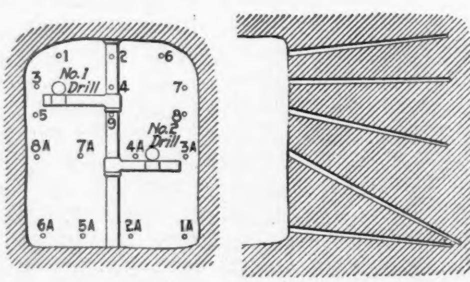
At the time of the writer's visit the tunnel had progressed 530 ft. northward, at which point soft ground was encountered; and it was decided to move the entire plant to the north end of the contract and drive back, in order to ascertain the exact extent of the soft material.

Fig. 2 is a diagram of the round. No. 1 drill, on the upper arm, puts in holes 1 to 9 in the upper half of the heading, and No. 2, on the lower arm, drills holes 1-A to 8-A. No. 2 drill, as a rule, has one less hole to drill than No. 1, owing to a more awkward position. Two drillrunners, a nipper and two muckers constituted the tunnel crew for each shift.

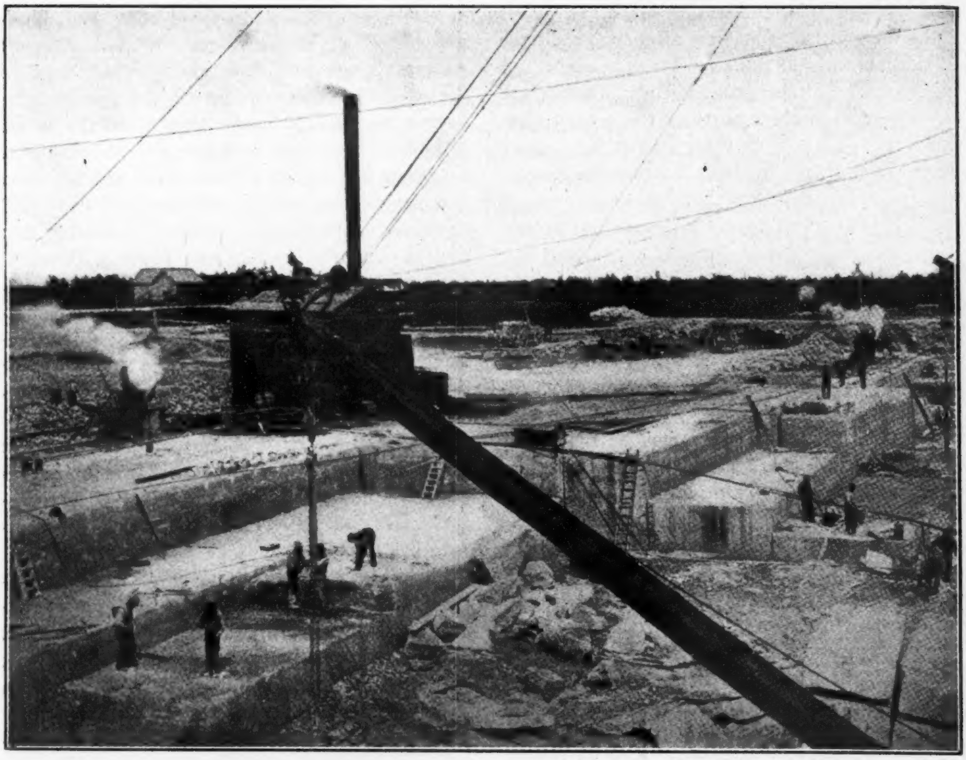
Holes 1-A to 8-A in the lower half of the heading were loaded first and fired together; then holes 5, 8 and 9 in the upper half and, lastly, holes 1, 2, 3, 4, 6 and 7. All holes were bottomed at 1⅝ in., 1¼-in. powder being used.

The average footage was 4 ft. per round, but when the tunnel broke high, allowing the use of a 6-ft. steel for holes 3-A, 4-A, 7-A and 8-A, as much as 5 ft. could be pulled. The total time for drilling the round, which included removing the heading muck far enough back to set up the drill column, amounted to from 4 to 5 hr., the loading and shooting consuming about 3 hr. Water, when encountered, was handled by a simple steam siphon. Drill steel was sharpened by hand. Crossbits were used.

Track was laid to within a few feet of the heading, to facilitate mucking operations. The muck was loaded into a bucket, set on a trolley pushed by hand to the shaft, the bucket hoisted to the top and the muck dumped close beside the shaft. A 2-drum hoist was used.



The powder used was gradually reduced to 10 lb. per cu. yd. of solid material—approximately 10 lb. per ft. of advance. The rock, for the most part, broke rather small for economical handling, but this was to be expected, owing to the small size of the tunnel and the necessarily close spacing of the holes. The dynamite was 60 per cent.—*Engineering News.*



FREESTONE QUARRY IN MANITOBA.

ANCIENT AND MODERN QUARRYING PRACTICE*

Any one who has contrasted the quarries of the old and the new world must have been struck with the difference in the methods used for operating them. Of course many of the European quarries were worked long before the perfecting of modern machinery, and consequently are more ragged and broken than would be the rule now. But still those that have been opened in comparatively recent years do not show the sharp and clean cut ledges and the level floors that mark most of our quarries. Nowhere else in the world can be seen the vast rectangular pits, descending floor after floor in regular steps, such as will be found in Vermont, New York, Georgia, Indiana, Ohio and other states, where the quarrying industry has assumed large proportions. In these quarries the stone is cut from its ledges by machinery, almost with the accuracy with which wood is worked, and with the minimum of waste. This, of course, is done by means of the channeling machine, and there is a minimum of waste, as this cuts a channel only two or three inches in width. Even in the hard stones like granite where the ordinary channeling machine cannot be operated, it is customary in most of the large quarries to get a smilar effect by the use of a rock drill mounted on a horizontal bar, and a broaching bit. By this means it is possible to quarry to dimension and so avoid the great waste that comes from a dependence on explosives alone. We have many times called attention to the fact that, for some reason the ordinary

*Abstract from *Stone.*

English and continental quarrymen cannot be induced to employ these machines, perhaps because they are an American invention. They have been demonstrated across the ocean but that they do all that is claimed for them seems to have no weight.

Perhaps it is an indication of a better spirit that one of the latest marble quarrying operations undertaken by Englishmen and financed by English capital, has introduced in its equipment the Ingersoll channeling machines. This is the enterprise that has already grown to considerable proportions on Marble Island, off the coast of Spitzbergen. Such appliances are very essential in these particular operations because the beds of marble lie flat and there are no open faces or ends. From the photographs of the deposits that we have seen, it would appear to be purely a channeling proposition.

In a large number of the British quarries the same methods are followed that were in use before the development of steam power. Where the beds have to be worked on two or more sides it is customary to dig trenches at least eighteen inches to two feet in width with hand picks so that wedges can be driven at the bottom. It needs no argument to show how wasteful and primitive this method is. One of the leading producers of a free working stone that is widely used throughout England for building purposes, is compelled to extract most of its stone from underground workings. Here would seem to be the place where channelling machines were imperatively demanded, the operations being conducted in a similar manner to the extraction of marble from the great underground quarries at West Rutland, Vermont. The actual method that is followed seems to be very crude and wasteful. Projecting pillars or buttresses in the various chambers are cut loose by handsaws. To give room for the workmen to ply their saws it is necessary first to pick away a considerable amount of good stone.

When we have spoken of the American quarries the reference has not been solely to those in the United States. Our Canadian brothers are enterprising and progressive and some of their quarries are models of equipment. The accompanying illustration of a big freestone quarry in Manitoba makes striking appeal in these days when the watchword is "efficiency." One does not have to know much about quarrying methods to realize that here the stone is extracted in the most effective manner and that there is no unnecessary waste. Of course the deposit is admirably adopted for quarrying operations but it is certainly not unique in this respect. We venture the assertion that nowhere except in America, unless it be in Belgium, can one find a stone deposit worked in so satisfactory and efficient a manner.

While we have made these efforts to eliminate waste and useless cost in most lines of quarrying, an exception must be admitted in the case of the slate industry. Here there has been scarcely any improvement and the waste is almost prohibitive. The vast mountains of refuse in all of the slate centers are not only a terrible disfigurement of the landscape and the cause of much expense to all operators, but they frequently prevent the possible development of the business. Owing to the nature of the stone and the formations it would be impossible ever to reduce the percentage of waste as low as in the quarrying of a structural or decorative stone. Still much could be accomplished if a close and thorough study were made of all of the problems of quarrying and dressing slate. Instead of this, the operators cling to the out-worn methods of their forefathers and seem actually to resent any innovations.

Perhaps one reason that will account for this is that the great majority of the quarryman are Welshmen, with all of the conservatism that marks the Briton. A peculiar fact must be noted here; the slate quarries of North Wales are operated in a more progressive manner, as a rule, than the stone quarries. Doubtless the reason for this is that many of them are worked by their wealthy owners, and trained engineers are put in charge.

COMPARATIVE EFFICIENCIES OF COMPRESSORS AND BLOWERS

In *Engineering News* of Nov. 4, 1915, in discussing air compressors for activated-sludge tanks, Carl H. Nordel, engineer of design of the Milwaukee Sewage Commission, gives the following summary of efficiency of various types of compressors for low and medium-pressure services—such as are used in smelting and converting operations.

The mechanical efficiency of the reciprocat-

ing compressor, as ordinarily measured by comparing the work done in the steam and air cylinders, is usually in the neighborhood of 85 to 90 per cent. The higher the pressures it is necessary to employ the more this figure will be reduced. The older types of compressors are less efficient than the later ones. The introduction of large thin-plate valves has reduced air velocity through ports and cut down the heating at this point. The higher the pressures the hotter are the cylinder walls—even with good cooling systems—and the greater is the reduction of air taken in for compression. Tests on plants in operation show that such losses in compression may perhaps be 25 per cent. (besides the 10 or 15 per cent. mechanical losses mentioned) for the higher pressures.

The first cost of reciprocating compressors is comparatively high, and they are bulky in proportion to their output. They may be had in any capacity from less than 100 cu. ft. per min. to the large blowing engines of from 40,000 to 50,000 cu. ft. per min.

LIMITATIONS OF THE TURBO-BLOWER.

The turbo-blower is a comparatively recent development. It is substantially a turbine pump. The pressure is secured by imparting a high velocity to the air, with a subsequent transformation of the velocity head into pressure head. Water weighs about 800 times as much as air; hence to secure the same pressure rise per stage with a blower as with a pump, the velocity would have to be 28 times as great. In consequence the rotative speeds are usually carried as high as safety will permit. The impeller tips are sometimes run at 600 ft. per sec., when as much as 3 to 4 lb. pressure can be secured in a single stage. Ordinarily, however, 2½ lb. is considered the limiting pressure per stage.

These blowers are well adapted to handling large volumes of air. Being high-speed machines, they are compact and comparatively inexpensive for their capacity. The larger units show a good efficiency, often reaching 75 per cent.; but the efficiency falls off with the size. Driven by direct-connected steam turbines, excellent overall economies are secured. The guaranteed steam consumption for units delivering in the neighborhood of 30,000 cu. ft. per min. is as low as 15½ lb. of steam per hour per air horsepower.

The steam-turbine-driven units have a flexible delivery, even at constant pressure, and by slightly varying the pressure high efficiencies over a large range of deliveries can be obtained.

A complete line of turbo-blowers direct-connected to high-speed motors and delivering from 2,000 to 40,000 cu. ft. per min. has been developed. Variable delivery at constant speed over a fair range, without too great loss in efficiency, can be secured by throttling the discharge and intake.

Positive-pressure blowers operate on the same principle as a rotary pump. Lobed impellers meshing with each other in a manner similar to the teeth of a gear revolve within a casing, sweeping the air before them. The impellers do not quite touch each other or the casing and there are consequently clearance spaces through which some of the compressed air leaks back. With well-made blowers the clearance is small and the leakage fairly low.

The amount of leakage is constant so far as the speed of the blower is concerned, but varies with the square root of the pressure. Hence these machines become less efficient as the pressure is increased, and this tends to limit their use generally to pressures below 10 lb. The leakage or slip is measured by the number of revolutions of the blower required to make it good. Thus, if the slip is 100 r.p.m. and the speed of the machine is 500, the volumetric efficiency is 400 r.p.m., or 80 per cent. The capacity of the machine is usually stated in terms of the displacement per revolution, and the delivery is equal to the displacement multiplied by the rotative speed minus the slip. Obviously, the higher the speed the better is the efficiency.

The losses other than slippage are small. Probably 5 to 10 per cent. would cover all losses outside of slippage.

As the intake port is very large, the air is not heated on entering the blower, and thus a good volumetric efficiency is assured. Efficiencies based upon the power input range from 60 to 85 per cent.

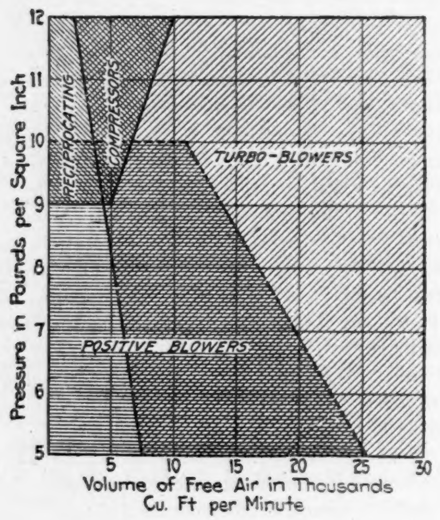
The positive-pressure blowers are comparatively slow-speed machines, ranging from 600 r. p. m. in the small sizes to 100 in the larger.

The positive-pressure blower is not well suited to a variable delivery, as the efficiency falls off with the speed.

There is another type of compressor that possesses peculiar interest—the Taylor hydrau-

lic compressor, which has been so successfully installed in some mining districts.

This apparatus uses the weight of falling water to compress the air without the application of any intervening machinery. The water is allowed to fall through a shaft and in doing so it sucks in air through a large number of small pipes and entrains it in small bubbles, which it carries to the bottom of the shaft. After descending far enough to secure the required pressure, the mixture of air and water is allowed to flow horizontally, whereupon the air separates out and fills a reservoir from which it is drawn as needed. Excellent results have been obtained with several installations, notably at the Vistoria mine, Michigan, and at Cobalt, Ontario. The former compresses 36,000 cu. ft. per min. to 128 lb. gage pressure with an efficiency as high as 82 per cent. This remarkable showing is explained in part by the fact that the compression is absolutely isothermal, the water absorbing all the heat as rapidly as it is generated.



LIMITS OF EMPLOYMENT FOR DIFFERENT TYPES OF BLOWERS.

The accompanying diagram gives about the economical range for three familiar types of blowers if the delivery is to be nearly constant, though such a diagram can naturally be only approximate.

COMPRESSORS DOWN IN THE MINE

By Charles C. Phelps.

Until quite recently it has been rather unusual practice to install compressors underground in mines. Undoubtedly there have been many instances where local conditions would have dictated such underground compressor installations had units wholly suitable for such service been available. Many compressors, as made at the present time, both portable and stationary units, are well adapted for underground service. The advantages of the portable type have been appreciated particularly by the coal mines, where many such plants are in use.

Under certain local conditions a permanent underground stationary plant has been found to possess certain unique advantages. One of the first mines to apply these advantages was the Humboldt mine, Ouray, Colo. Over 3 years ago this gold mine installed in a cavity cut out of the rock in the mine an Imperial "XB-2" compressor, short belted to a 150-hp. Fort Wayne motor. The primary reason for placing this unit underground was to avoid the difficulties encountered with snow slides. The compressor was placed 1200 ft. from the portal of the tunnel in order to reduce the length of pipe line to the drills. The compressor has a 16-in. stroke and the 2-stage cylinders are 20 and 11 ins. respectively in diameter, giving a piston displacement of about 850 cu. ft. per minute at 150 lbs. pressure. This compressor is installed at an altitude of 12,000 ft. It is a standard machine, excepting that shipment was made with frames split, and the whole compressor was knocked down to facilitate handling in the limited space of the tunnels. A comparatively small amount of rock had to be excavated in order to permit the installation of the machine, as the unit was exceptionally compact, due to the short belt drive. A better idea of the suitability of this type for underground use will be gained from the description of it given later. Barely enough room was left around the machine for the passage of the attendant.

At the Mount Champion mine in the Leadville district, there is a similar installation, also placed underground principally to avoid trouble with snow slides. This property is located about 13,000 ft. above sea level on a steep

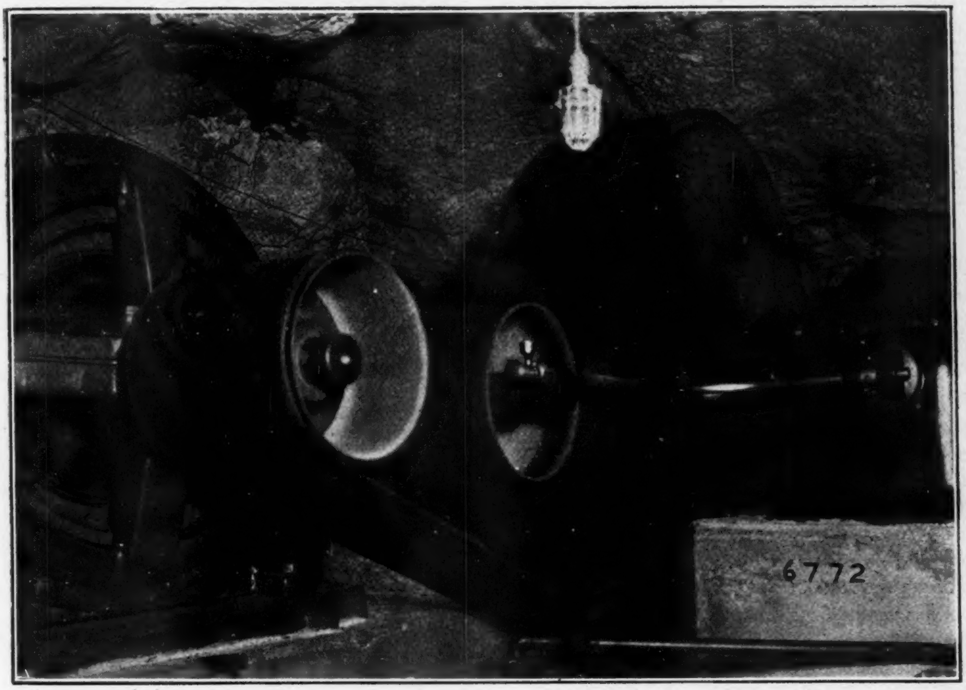


FIG. I. THE SHORT-BELT DRIVE AT THE RAINBOW LODE DEVELOPMENT CO.'S PLANT, BUTTE, MONT.

barren hill. This compressor is an Imperial "XB-2" with a stroke of 14 ins., cylinders 18 and 10 ins. diameter and is driven through short belt-drive by a 100-hp. General Electric motor. The piston displacement is about 750 cu. ft. The outfit is located about 75 ft. from the surface and is used for operating drills. This equipment was also shipped knocked down, and as little rock as possible was excavated to accommodate it.

At the Wilkeson Coal & Coke Co.'s mine at Wilkeson, Wash., there is a smaller unit installed underground — an Ingersoll-Rogler Class "ER-1" straight-line compressor, short belted to an electric motor. This plant is about 1½ miles from the entrance to the mine. The compressor has a 12-in. stroke and 14-in. diameter cylinder, with a piston displacement of 464 cu. ft. per minute.

It is probable that in each of the above cases a compressor with an ordinary belt drive would have been out of the question, due to the great expense that would have been involved in removing sufficient rock to accommodate it. The Humboldt mine compressor plant, for instance, has an over-all length of about 19 ft., an over-all width at the compressor end of 10½ ft., and a height over the flywheel of about 8 ft. A corresponding unit of the ordinary long belt type would have the over-all length increased to about 40 or 45 ft. The over-all length of the Wilkeson plant is about 17 ft., the width about 4½ ft. and the greatest height about 6½ ft. A corresponding unit of the ordinary long belt type in this case would have the over-all length increased to about 35 ft. The compactness of the short-belt type is exceptionally well illustrated in Fig. 1.

In addition to the exceptional compactness of the short-belt compressor, the enclosed construction, preventing the entrance of dirt and dust to the working parts, and the automatic oiling system well fit this type for underground service.

There are other advantages to the short-belt drive besides compactness. Increasing the initial tension in a belt increases the pressure on both motor and compressor pulleys, increasing the frictional resistance and converting into heat a certain amount of the energy, which is thereby lost to any useful purpose. It also decreases the life of both belt and bearings. On the other hand, leaving a

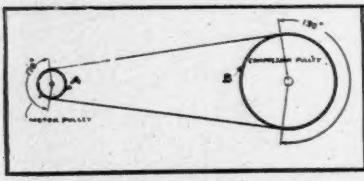


FIG. 2.

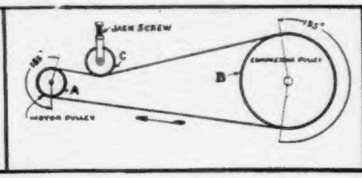


FIG. 3.

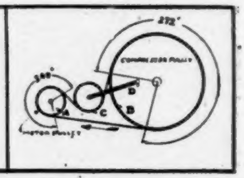


FIG. 4.

belt loose permits excessive slippage of the belt on the pulleys, which also greatly lowers efficiency. It is obvious that the greater the arc of contact of the belt on the pulleys the less will be the slippage. For that reason it is customary, when employing the long-belt drive, to place the motor and compressor pulleys sufficiently far apart to ensure a reasonable arc of contact. From Fig. 2 it is apparent that the belt contact on the motor pulley is none too much, but is about all that can be obtained by this arrangement. Fig. 3 shows how a stationary idler pulley is commonly applied when belt slippage is experienced with the arrangement of Fig. 2. Although overcoming the slippage problem, this only re-introduces the tight-belt evil. In the short-belt device, illustrated in Fig. 4, C is an idler pulley which is carried on arms swung from the compressor frame at D. Thus instead of being fixed in position, it "floats" on the belt, and is free to rise and lower. The short belt drive, illustrated in Fig. 4, has practically zero initial tension, as the weight of the idler is very small. As soon as the motor starts, tension increases in the lower side of the belt, the upper, or slack side, lengthens and the idler pulley lowers, taking up the slack, and at the same time wrapping the belt farther around the driving pulley, giving a greater arc of contact for the greater power transmitted, the scientifically correct arrangement. Greatly reduced belt and foundation costs are additional advantages of this type of drive, applying equally to underground and above ground installation.—*Min. and Eng. World.*

Among the "safety first" slogans of the Inland Steel Co. are the following:—"Any fool can take a chance; it takes brains to be careful." "When hurry interferes with safety, cut out the hurry." Cutting out the hurry is essential not only for safety, but also for efficiency.

A NEW TYPE OF VACUUM PUMP

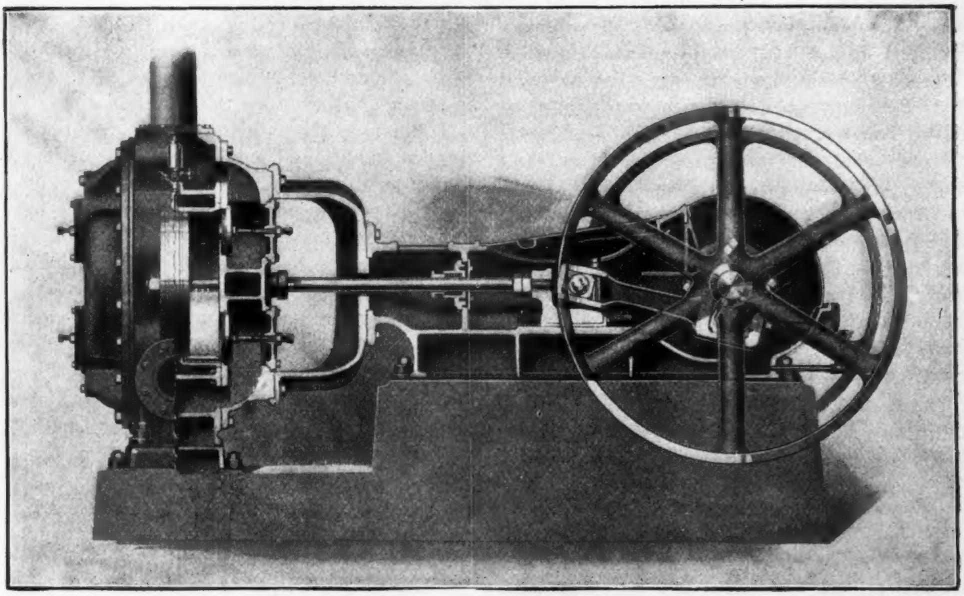
The Ingersoll-Rand Company has recently placed on the market a new dry vacuum pump, the "Ingersoll-Rogler." This type of machine has been developed, from the Company's line of straight line air compressors, for condenser service and other duties requiring the maintenance of a high vacuum.

These machines are of the horizontal, center-crank type and are built both steam and power driven. A feature, pointed out by the maker to be a marked improvement, is the substitution of an automatic lubrication system for the usual grease cups found on machines of this kind. Removable cast covers prevent the lubricant from escaping and, while affording quick access to all parts, completely exclude dust and grit.

The vacuum cylinders are fitted with "Ingersoll-Rogler" valves, a type which has proven highly satisfactory in air compressor service. They are automatic in action. These valves are of the multi-ported plate type and are featured by ample port opening with very slight lift. It is also to be noted that these valves need no lubrication. Inlet valves are placed in the top and discharge valves in the bottom of the cylinder heads, which construction provides for the immediate discharge of any liquid entering the cylinder. Water jacketing on both cylinder barrels and heads is said to increase the efficiency by keeping down the heat generated in the vacuum cylinders.

The power driven machine (Class "ER") is often furnished with short-belted electric motor as a complete unit, as well as with plain belt wheel for other drive.

The steam driven type (Class "FR") has a balanced piston steam valve which permits its operation on high pressure and with superheated steam. Both vacuum and steam cylinders are lubricated by a force feed lubricator. These Class "FR" machines are furnished with a continuous sub-base under the entire unit.



NEW VACUUM PUMP.

Due to the high operative speeds, permissible with low lift plate valves of the "Ingersoll-Rogler" type, it has been possible for the manufacturer to so increase the capacity of a pump of a given size that in comparison with equal capacity machines of the old type the floor space occupied is reduced to a marked degree. This saving is said by the Ingersoll-Rand Company to be about two-thirds.

"Ingersoll-Rogler" Vacuum Pumps range in capacity from 292 to 2295 feet per minute and are guaranteed by the manufacturer to maintain a vacuum of within one-half inch of barometer against a closed intake. They are also capable of handling discharge pressures of several pounds.

COMPARISON OF "ECONOMIES" IN OFFICE AND MINE

BY LETSON BALLIET.

The other day I was in the office of the manager of one of the large mining companies of the west. I noted that the office was furnished with golden oak furniture, an elaborate system of filing cabinets, an expensive adding machine, two fine typewriters, a check writing machine, an addressing machine, with every detail of office equipment modern and up to the minute.

While I was in the office, a salesman for one of the typewriter companies called, and after some talk, made arrangements to take the two perfectly good typewriters at $40 apiece in exchange for two new writing machines, requiring $65 cash payment upon each of the new machines.

An hour later a salesman representing a pneumatic rock drill called to explain the merits of a new and improved model. The manager showed but little interest, and finally dismissed the salesman with the remark that "I don't need any new drills right now; the old ones are giving good service yet."

After the salesman had left, I evidently showed that I was amused at something, for the manager inquired "what are you smiling at?" "Not much," I said. "I was just wondering why you didn't tell that typewriter salesman the same thing that you did the drill man—and say, 'I don't need any new typewriters right now, the old ones are giving good service yet.' "

He was relieved from the embarrassment of answering by the entrance of the mine foreman at that moment. There was some conversation about a mine pump that I couldn't hear, till the foreman lost his temper and said in a loud voice, "the d—n thing is always giving trouble, and we lose two or three hours

every few days monkeying with it, and doctoring it up." To which the manager replied, "I'll send Smith (a machinist) down to fix it up.' I smiled again, as the manager returned to me, and I asked him: "Why don't you cancel the order for those two typewriters and buy a new pump? It seems to me that you could make more money for your company, saving the time and worry on that pump, than you can in changing typewriters in this office. You are losing $20 every time that pump hangs up your work for two or three hours, and it wouldn't take long to save enough to pay for a new pump."

The shot went home, so I followed it up with this question: "How many men have you on the payroll of the mine?"

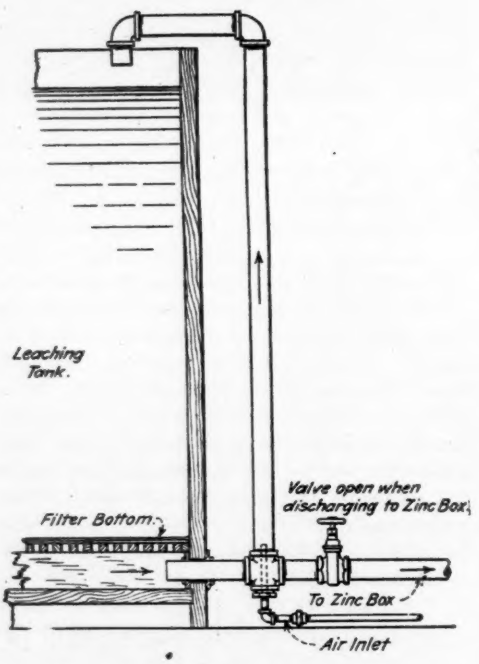
"Eighty-two," he replied.

"How many are employed in this office?"

"Two besides myself."

"Now tell me," I said, "why is it that you think you are an efficient mine manager when you have everything from office furniture to inkstands brought up to the very latest models in efficiency for the use of *three employees,* while you force *eighty-two* employees of the same company to work with old wornout and obsolete drills, a second-hand pump that was about worn out when you put it in the mine, and pipe lines that are leaking more compressed air to waste than you use. You want the finest tools for your office work, yet your men are working with rusty handsaws and axes with cracked handles, the cheapest shovels and picks that you can buy. You want 14 electric lights in this office (I counted them), with big tungsten globes, and expect your miners to do efficient work with defective tools in the light of a candle. More than that you have dozens of pen holders in this office and plenty of everything else; and I saw a note hanging in the foreman's office this morning, where it had been left by the night foreman, which read: 'What became of those two wrenches that were on the 1200-ft. level?' I noticed that the day foreman brought two new wrenches out of the storehouse and sent them down on the first cage; but how would it sound to ask: 'What became of those two pen holders that were in the office yesterday? You'd think you were losing money if a couple of office clerks couldn't find pen holders, but you don't think it costs anything for twenty or thirty men on the 1200-ft. level to be working with 'two wrenches,' while the night shift couldn't get any new ones till the day foreman came to open the storehouse."

If this was the only time I had ever noticed similar conditions I wouldn't say a word about it, but in the last twenty years I've been in a good many mines and mine offices, and I have the first one to see where something on this order wasn't to be found. How a mine manager can think he is efficient, with a showy office equipment, and $25,000 monthly expense to do work that $10,000 ought to do in the mine, is more than I can understand. There isn't one mine manager in a hundred who could *get by* in a big factory with this method. —*Min. and Eng. World.*



AIR LIFT HASTENS LEACHING

While leaching seems an old-fashioned subject, there are a great many plants in which the leaching of the sand is carried on with the agitation of the slime, so even at this late date, it seems to me, suggestions on the improvement of this phase of cyaniding are not out of place.

The Zopilote mill in Tepic, Mexico, was of this type. In order to increase the capacity of

this mill, without additional equipment, it was necessary to increase the proportion of sand to slime in the crushing department and, to handle this increased tonnage of sand, the time of leaching had to be cut down. I accomplished this by the introduction of air-lifts in the solution-discharge of the tanks, as is shown in the sketch. In this way the solutions were kept in constant motion in the tanks and a freshly aerated solution was continuously supplied to the ore with a surprisingly small consumption of air, the lift being less than a foot and the total length of the column being less than seven feet.

This simple arrangement cut down the time of treatment 33 per cent. with an increased extraction and, at the same time, cut down materially the zinc consumption, as the solutions were not precipitated until they were much richer than under the old system.—*Clark Sullivan in Mining Press.*

ATMOSPHERIC PRESSURE AS AFFECTING HEALTH AND COMFORT*

From the multitude of problems recently presented, the one considering the relationship between air pressure and health appears now to be the most popular. There is considerable misconception regarding this subject occasioned primarily by confusing effect with cause. The mere change in atmospheric pressure from day to day has nothing whatever to do with one's physical well-being. The recent publicity given to this subject during the last few months is simply a revival of a myth laid a generation ago by Thomas. For example, in a recent public bulletin it is stated that when the barometer drops from 30 to 29 inches from one day to the next the human body is relieved of half a ton of atmospheric pressure, with resulting depression of spirits, etc. In the first place, it is quite unusual for the barometer to drop one inch in so short a time, and in the second place, experiments have proved that the influence on the body of variations in pressure is greatly overestimated.

Hann quotes Thomas and says that in experiments with pneumatic chambers, pressure changes amounting to 300 millimeters (over 11 inches in barometric values) a day have been produced without causing any injurious effects on the sick persons concerned in these experiments. Although these experiments were made nearly half a century ago, the pressure myth has persisted, and even this year has found its way into sober-minded periodicals. If a local example is needed to demonstrate further the untenability of the pressure theory, we have only to recall that in Los Angeles, for example, the range of the barometer from day to day averages a tenth of an inch of the mercurial column, equaling the variation experienced when riding in an elevator from the ground floor to the top of office buildings. If there was anything in this theory we would have an "elevator disease" among the elevator conductors who continually experience excessively rapid fluctutations in bodily pressure.

HUMIDITY HAS MORE EFFECT THAN PRESSURE.

It is rather the fair weather and decreased humidity which accompany rising barometric pressure that elevate one's spirits, or the cloudy threatening weather and increased humidity which accompany a falling barometer that affect the human system. Dr. C. C. Browning noted this when his studies showed that the tuberculosis patients became pessimistic and some very unreasonable in their demands during days with little or no sunshine and hopeful of recovery during bright days and moderately low humidity.

SUNSHINE AND AIR MOTION MOST IMPORTANT.

I believe that the location of the home or office, the exposure of the living or work room has more to do with the health of the occupant than whether or not the relative humidity is much below or above normal. Exposure to sunshine and ample ventilation are all important. A friend complained of ill health and blamed the humidity of his office room. He said that it was too damp and asked me to investigate. I took my psychrometer and made a series of observations, finding that there was actually less humidity in his private office than out in the street. I studied the situation and eliminated temperature, humidity, air pressure, etc. Then I turned to air movement, and found the ventilation very bad. I suggested a simple air changing system and my friend regained his health in a few weeks, and was still enjoying his private office when I last heard from him.

*From a paper by Ford A. Carpenter, LL.D., before American Climatological and Clinical Association.

AIR DRAINAGE.

Facing houses with relation to natural air drainage is a most important point in selecting a home. Many a home, otherwise healthful and satisfactory in every other respect, has been abandoned because the architect and owner did not consider the principles laid down by Hippocrates two thousand years ago.

POWER COST OF AIR LIFTS

Charles Legrand, of Douglas, Arizona, consulting engineer for Phelps, Dodge & Co., at the San Francisco meeting of the American Institute of Mining Engineers, discussed the characteristics and qualifications of the various types of pumping apparatus employed for the unwatering of mines.

Of the air lifts he spoke as follows:

As to air-lifts, these are inexpensive to install and will handle large quantities of water in a small space, where proper submergence can be obtained. The method could not be used from the lowest level of a mine without a lot of complications, as there is no way to get the proper submergence. Although air-lifts require a good deal of air, the other running costs are almost nothing. Air-lifts were used at the Old Dominion mines at Globe during a recent emergency. Two 10-inch air-lifts, raising the water 200 ft. and 431 ft. respectively (excluding friction) taking air at 90 to 95 lb. (at the power-plant) required the following amounts of air (measured by flow-metre) at a barometric pressure of 27 in. of mercury, the submergence in each case being 190 feet.

Gal. per min.	Cu. ft. free air per min.	Cu. ft. free air per 1000 gal.	Steam consumption.
1680	1809	1080	48.7
1794	2262	1261	57.5
1122	3051	2718	57.0
1233	3395	2753	57.6

The steam consumption per water hp.-hr. is based on air-compressors requiring 38 lb. of steam per 1000 cu. ft. of free air, delivered compressed at 90 lb. gauge-pressure.

BOILER EXPLOSIONS IN GERMANY

In the entire Empire of Germany, not including those used in the military and naval service, there were, in 1914, only eight explosions of steam boilers. One of these was built in 1873, one in 1874, one in 1880, one in 1881, one in 1892, one in 1902 and two in 1906. The dates are mentioned as showing that all the boilers were well along in years; the most were of the last century. Low water is given as a probable cause in five out of the eight cases. In three of the explosions no personal injuries were caused. The other five killed two, seriously injured two and slightly injured seven persons.

In the same period there occurred in the United States 575 accidents to boilers, by which 300 persons were killed and 476 more or less seriously injured; and yet there are those who protest with all of the outraged righteousness of American citizenship imposed upon against any governmental control or supervision of the design and operation of boilers, or of the competency of the men that run them.—*Power.*

A NOVEL CONSTRUCTION FOR GAS HOLDERS

The floating bell form of gas holder, with its telescoping sections, water tank seal for the lower edge and elaborate framing for guiding the cylinder, is a very expensive structure, and it has not been evident how it could be improved. A new principle has, however, been devised that greatly simplifies the construction and reduces the cost. Instead of being movable the tank is fixed, and its roof is movable, sliding up and down within. This roof is fitted as closely as possible, and to prevent the gas escaping water is pumped onto it, thus forming a water seal. Of course some water passes through the joint, but this is withdrawn and returned to the roof by a pump regulated to compensate for the leakage.

A FACTORY PERISCOPE

The men in the fire room of a factory cannot always tell, without going outside to look, whether the chimney is smoking, and this is important, both as a matter of economy in burning the coal, and also to enable them to conform with smoke regulations. A writer in *Power* suggests placing a mirror outside the building and setting it at such an angle that the men, looking out of the window, can see the reflection of the top of the stack in the mirror. In some cases, where one mirror cannot be properly located, two might be used for the purpose.

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CONTENTS

WILLIAM SOOY SMITH

General William Sooy Smith—or, as frequently written, Sooysmith—who died at Medford, Oregon, March 4th, had a national reputation as a foundation specialist, especially in his development and wide employment of the pneumatic caisson. He also successfully employed the freezing process in excavating for foundations in water-bearing strata.

He was born at Tarlton, Ohio, in 1830 and after the usual common school experience received his professional education at the United States Military Academy at West Point, serving in the army a year after his graduation. There being little of interest doing in the army at that time he resigned to engage in engineering work on the Illinois Central Railroad which was then being rushed for the rapid development of the State. Then he became assistant engineer to the U. S. engineer in charge of the improvements in the harbors of Lake Michigan, from which position he was compelled to resign on account of ill health. In 1857 he was appointed to the responsible position of chief engineer, age 27, on the construction of an iron bridge across the Savannah River for the Savannah & Charleston Railroad.

At the beginning of the Civil War he was a colonel of infantry, distinguishing himself on many occasions and successively rising until he attained the command of a division and became chief of cavalry under Gens. Grant and Sherman in the military division of the Mississippi. His strenuous life and exposure brought him near to death from inflammatory rheumatism and being incapacitated for further service he resigned.

After having sufficiently recovered his health he resumed practice as a civil engineer in Chicago, and did work both as engineer and contractor for the U. S. Government and for the railroads. An epoch making job was the reconstruction of the Waugoshanee lighthouse at the western entrance of the Straits of Mackinac, for in the construction of the heavy sea wall around the lighthouse he used his first pneumatic caisson and so far as known the first used anywhere. In this period also he built the first all steel railroad bridge in the world at Glasgow, Mo. and the substructures of six other bridges by the pneumatic process. He completely changed the methods of constructing the foundations of heavy

buildings in Chicago, carrying the loads down through mud and soft earth to hard bottom 50 feet or more by means of piles cut off below the water surface. In some cases to avoid danger to adjoining buildings columns of solid concrete were sunk to hard bottom and the buildings were erected upon them.

In this brief sketch we have followed principally the obituary of the Engineering Record. It will be gathered that Gen. Sooy Smith was probably the leading authority both in theory and practice as to all the means and methods employed in the building of foundations, and his various achievements in this line were examples to be followed, often of course with successive improvements, by the advanced engineers of the world. It is not easy to realize what a prize to engineers was the pneumatic caisson, and still more difficult to find out what we could do without it. The special habitat of the pneumatic caisson would seem to be downtown New York City, where the surface of the primeval rock is at such a level below tide water, with a porous soil above it, as to supply the precise conditions where the caisson applies. If the rock surface were fifty feet higher, as it is farther uptown, the caisson would be superfluous, and if the rock were fifty feet lower the use of the pneumatic caisson would be impossible as the pressure would be beyond the endurance of the sandhogs. As it is, we have such a building as the Equitable or the Bankers' Trust, the superstructure-supporting, water-excluding foundation of which is a continuous pneumatic caisson, concrete filled, all around the enclosure, with sufficient piers distributed over the area within to carry the enormous weight with an absolute and enduring safety never exceeded in the world.

THE BRASHER COMPRESSED AIR BREAKWATER ON THE PACIFIC COAST

This device, which has more than once been described in our pages, proposes to overcome the violence of breaking waves along the coast by the discharge of compressed air up through the water from submerged pipes paralleling the shore line. Sufficient exhibitions at points on the Atlantic coast have been given to demonstrate great possibilities of success if adequately installed, and now we have information of another most encouraging trial at El Segundo in the neighborhood of Los Angeles as narrated in local papers of recent date.

When the heavy storms struck the coast of California last year 2000 feet of the Standard Oil wharf was destroyed and washed out to sea, and to prevent similar destruction this year the Brasher system was tried, though only in a small way, and the wharf at El Segundo stood intact in spite of the powerful waves. Air pipes were laid 145 feet out from the end of the wharf covering an area 120 feet wide, and two other pipes, each 100 feet long extended out from the sides of the wharf. When the storm arose the compressor on shore, working continuously, sent the air through the pipes and it escaped through the small perforations and was distributed in bubbles through the body of water, thus contributing an elastic clement which entirely transformed the action and effect of the wave movement.

The device should be of great practical value in connection with engineering operations in exposed situations. According to Mr. Brasher: "It would do away with breakwaters and seawalls, would protect coffer dams, and would permit dredging and salvage operations in all sorts of stormy weather. Dredges could be kept working in the most exposed places during the roughest weather. The erection of permanent breakwaters, piers, lighthouses and dams might be continued steadily, no matter what the weather conditions. Half completed structures might be protected until finished. Lightships could ride out the roughest gale in an artificial lagoon of calm sea. Stranded vessels could be protected from the pounding of the waves until floated. It would permit the coaling of ships at sea under any conditions. With it soldiers might land on a hostile shore when the sea was at its roughest."

AN EAST RIVER TUNNEL BLOWOUT

There are now being driven through the soft and treacherous material under the East River four tunnels—two pair—for additional passenger traffic lines between Manhattan and Brooklyn. The difficulty and danger of the work are now sufficiently well known, so that the work goes on without public mention unless some unusual incident occurs.

A serious and fatal blowout occurred Feb. 19 in the north tunnel of the South Ferry—

Montague St. subway. The tunnel is being driven by the usual shield method, and had reached a point about 600 ft. from the Brooklyn shore. The excavation had proceeded apparently under a pocket or depression in the mud, leaving a very thin spot with 24 lb. air pressure beneath it. The shield in the heading was about to be driven forward by hydraulic pressure another step of 26 in., and for this purpose the shoring in the excavation was being removed by two sandhogs when a hole began to open in the roof in front of the shield. One of the men tried to plug the hole with a bag of sand, but was forced up into the water of the river, and immediately the two men also who were removing the shoring were blown up through. One of the three men was rescued from the river alive. As the hole enlarged water entered the tunnel until it was flooded. Work was immediately resumed, the first operation being the dumping of a large body of clay over the thin spot in the river bottom. A blowout of similar character occurred on Nov. 30 in one of the other pair of tunnels.

ALLOY STEELS

"Manufacture and Uses of Alloy Steels," is the title of Bulletin 100, just issued by the United States Bureau of Mines, Department of the Interior. Copies of this bulletin may be obtained by addressing the Director of the Bureau of Mines, Washington, D. C.

Alloy steels are bringing about a series of revolutions in various industrial fields in which steel plays an important part. Most elements that could be procured in sufficient quantity have been alloyed with iron in various proportions, either alone or in combination with others, in the search for useful alloy steels. Those steels that have gained and maintained for themselves a place in current use are discussed in this report.

Probably the first useful alloy steel was Mushet's self-hardening tungsten tool steel, patented in 1868. Fifteen years later chromium steel really containing chromium, was struggling for recognition for some purposes, the chief of which was for the manufacture of solid shot for piercing armor. In both of these steels the effect of the alloying element as used was in a way proportional to the amount contained. In 1882 Hadfield made his epoch-making discovery of manganese steel and demonstrated that in iron metallurgy it is not safe to take for granted anything as to the properties of an alloy of iron with other elements, basing one's opinion on past experience and knowledge, and that the effect of an alloying element may not be proportional to its content.

The bulletin treats of simple tungsten steels, simple chromium steels, mangenese steel, simple nickel steels, nickel-chromium steels, silicon steels, high-speed tool steels, and chromium-vanadium steels.

NEW PUBLICATIONS OF THE BUREAU OF MINES

Bulletin 86. Some engineering problems of the Panama Canal in their relation to geology and topography, by Donald F. MacDonald. 1915. 86 pp., 29 pls., 9 figs.

Bulletin 89. Economic methods of utilizing Western lignites, by E. J. Babcock. 1915. 74 pp., 5 pls., 5 figs.

Bulletin 114. The manufacture of gasoline and benzene-toluene from petroleum and other hydrocarbons. 1915. 268 pp., 9 pls., 45 figs.

Technical Paper 93. Graphic studies of ultimate analyses of coals, by Oliver C. Ralston, with a preface by Horace C. Porter. 1915. 41 pp., 3 pls., 6 figs.

Technical Paper 129. Metal-mine accidents in the United States during the calendar year 1914, compiled by Albert H. Fay. 1915. 96 pp., 3 figs.

Miners' Circular 20. How a miner can avoid some dangerous diseases, by A. J. Lanza and Joseph H. White. 1915. 24 pp., 4 figs.

VACUUM TRANSPORTATION OF DUST

A paper by T. C. Cloud in the Journal of the Society of Chemical Industry discusses the removal and conveyance of very fine material, such as, for example, flue dust from steam boilers, or impalpable powders produced in large quantities.

In a case with which the author had to deal, furnaces were producing a gas highly charged with arsenious oxide. This was to a large extent deposited in a complicated system of condensing chambers and flues, followed by filtration through bags in a bag house. The points at which it was necessary to remove the arsenious oxide from the bag house flues, etc., were numerous, and it was also necessary to deliver all the material to the packing room

where it could be packed in casks for marketing. After some experimentation a vacuum plant, of which the following is a description, was designed:

The vacuum pump at normal speed of 160 r.p.m. has a displacement of 20,000 cu. ft. per hr. and will produce a vacuum of 18 in. of mercury if all valves to the various branch mains are closed. In the packing house the pipe main enters a cyclone separator in which the bulk of the arsenious oxide is deposited. Following this is another small separator. Finally the air is drawn through a shallow layer of water and then passes to the vacuum pump. The cyclone separator has a small storage capacity, and the arsenical soot is automatically removed from this apparatus and discharged into the casks placed below. The smaller separator is furnished with baffle plates and a collecting receptacle from which the deposit is only discharged at long intervals when the vacuum is off. The water separator is arranged so that a small continuous supply of water can be passed through it, or it may be charged and discharged intermittently.

In the piping about the works all bends and entering branches are of large radius, and for moving the material upwards all vertical members are avoided and inclined pipes substituted. At numerous points capped branches are arranged, to which, on the removal of the cap, suitable flexible hose, either metallic or reinforced rubber, can be attached. A suitable nozzle is fixed on the end of the hose, and on inserting this into the accumulated deposit the latter is immediately sucked up and conveyed to the separating plant.

This plant having an air pump capacity of 20,000 cu. ft. per hr. deals with 1½ to 2 tons of collected arsenious oxide per hr., and the farthest point at which a branch is situated is about 200 yd. from the separator. The pump in this instance is electrically driven, working at the rate of 12 to 14 h.p. It has been found that all annoyance caused by the handling of this material is removed and respirators are superfluous.

FOR INDUSTRIAL PREPAREDNESS

The following circular issued by the Naval Consulting Board accompanies letters sent out to the selected members of the engineering societies in each of the several States of the Union:

For the first time in the history of this country, engineers have been called as a body to its aid. Their service is needed by the Government in the performance of a most important patriotic work. They have been asked to aid in the laying of the foundations of our structure of national defence. Upon every one of them there rests a personal responsibility. The Country needs their service, the President has asked for it, and the governing bodies of the Engineering Societies have confidently pledged it. It is earnestly hoped that each and every one will find it possible to accept this nomination by his Society and to co-operate in this non-partisan, non-political and wholly patriotic work.

Brief outlines of Plan for Inventory of Industrial Resources Available for the Support of the Army and Navy of the United States.

1. Selection by each of the five great technical societies of one American Citizen from each State in the Union, as per President Wilson's request of January 13th.

2. The formal appointment by the Secretary of the Navy of the men so selected as State Directors of the Organization for Industrial Preparedness and Associate Members of the Naval Consulting Board.

3. Each State Board of Directors consisting of five men thus appointed to organize for business—electing Chairman and Secretary.

4. The organization under each State Board of a corps of Field Aides selected from the combined membership of the five technical societies within that State.

5. The issuance by the Naval Consulting Board to each State Board of complete information as to the work in hand, the objects to be obtained, suggested methods of procedure, lists of members within the State of the five technical societies and all available data as to the industries of the State.

6. Examination by the State Board of their territory with reference to the number and geographical distribution of industries with relation to the Field Aides available for the Inventory.

7. Issuance by the State Boards to the Field Aides of Instructions and Blank Forms as supplied by the Naval Consulting Board.

8. Examination and checking by the State Boards of all completed field reports. Following up men to see that reports are sent in properly. Checking reports and supplying

any data lacking before sending them to Consulting Board.

9. The continuance of the Organization thus formed in order to insure to the Government the backing of the full industrial strength of the country and to secure for the largest practicable number of industrial concerns such an amount of Government business as will keep them in touch with the requirements of the Army and Navy.

REHEATING DRIES THE AIR FOR THE SAND BLAST

On damp days we experienced trouble from the moisture in compressed air causing the sand to clog in the nozzles of our sand blasts, and at times from one-third to one-fourth of the operator's time would be occupied in endeavoring to clear away the obstruction. Several ways were suggested for drying the air, such as using a filter composed of pebbles and spongy material or passing the air through calcium chloride which is successfully used as a laboratory drying agent. The method which finally offered a solution of the problem consisted of placing gas burners beneath the main air pipe leading to the sand blasts, and since this plan was put into operation we have had absolutely no trouble from moist sand causing the apparatus to clog.—*George B. Morris in Machinery.*

NOTES

The cuts and description of the pneumatic blacksmith hammer in our February issue should have been credited to Railway Age Gazette by whose courtesy we were permitted to reproduce them.

Current is being transmitted from Sweden to Denmark through a submarine cable between Helsingborg, Sweden, and Elsinore, Denmark, a distance of about ten miles. The power comes from waterfalls in Southern Sweden.

A natural-gas pipe line, 800 miles long, is being constructed from the wonderfully rich natural-gas fields of southern Alberta to Winnipeg, Manitoba, at a cost of $10,000,000. When the line is completed it will supply 20 cities and towns along the way.

It is stated by those who should know that a cow from a given amount of feed will return more human sustenance than any other animal, and she apparently never hurries and never works hard.

A clever scheme, that appears to have originated in Scotland, is to gather pollen from the flowers with a vacuum cleaner for use as food for bees. The heather on wide stretches of moors provides ample supplies, and it is said that in some places the young bees have been mostly reared on this pollen.

Rock-drilling by contract, with payment made her foot of hole drilled, has not usually worked out satisfactorily. The miners place the holes where they are drilled most easily rather than where the smallest number of holes will break the greatest amount of ground. A price of 6 or 8 cents per foot of hole drilled was paid in hard limestone in Missouri.

Beginning Jan. 1, 1916, Denmark has introduced the twenty-four-hour system of computing time. In other words, 1 P. M. is to be termed 13 o'clock, and so on until midnight, which will be 24 o'clock. This system, which eliminates all doubt as to whether a given hour refers to day or night time, has already been introduced in various European countries.

Lake Titicaca, between Peru and Bolivia, is slightly over 13,000 feet above the level of the sea and is navigated by steamers of about a thousand tons, plying twice weekly between Puno in Peru and Guaqui in Bolivia.

It has been estimated that at least 85 per cent. of all rubber used in manufacturing goes to tires and only 15 per cent. to mechanical goods. The United States alone uses about 100,000 tons of crude rubber per year.

The mining of brown coal is one of the important industries of Germany. The coal varies in color from dark brown to almost black and is soft like loam. Pieces of wood and strips of bark and even parts of tree trunks are frequently encountered in the excavation, although the coal for the most part consists of a pulverulent, more or less matted mass of small particles of vegetal matter. It is a product between peat and lignitic coal.

The Engineer, London, gives a description of a method which has been adopted for storing oil fuel under water for the use of submarines. One of the submersible barges spoken of is in the form of a tank 150 ft. long and 30 ft. diameter, with hemispherical ends, which would carry 2,400 tons of liquid fuel, and could be submerged by admitting water to the compartments at the ends. To bring the vessel to the surface compressed air was introduced to force out about 30 tons of ballast water, or either oil or water could be pumped out through flexible tubes to make the vessel rise.

The price of blue-print paper and blueprints is likely to advance materially in the near future. This is due to the increase in the price of all chemicals employed in the blue process and also to the big advance in paper. Red prussiate of potash has been made exclusively in Germany. Before the war it sold for 19c per lb.; today it is practically unobtainable at $7 per lb., or an advance of 3,500 per cent. Citric acid, from which the citrates of iron and ammonium are made, has advanced 150 per cent.; and oxalic acid, from which the oxalates of iron are made, has advanced 1,000 per cent. in the same time.

It is estimated on fairly reliable although not official information that in England 27,000 men are engaged in building heavier-than-air flying machines. In addition, there are men engaged in building auxiliary equipment such as magnetos and carbureters. It is no exaggeration to say that in Great Britain alone about 40,000 men are now engaged in aeroplane work. It is stated in Germany by well-in formed people that the English factories have an output of 140 machines a week. The French factories are doing their part; several plants in the United States and Canada are doing theirs. In Germany four big factories have been turned over to aeroplane building, among them one of the largest plants of the Allgemeine Elektrizitats Gesellschaft.

There was an apple orchard of four thousand trees to be planted, and as winter was approaching, no time could be lost, lest a sudden turn in temperature should freeze the ground. The man who undertook the work first mounted a 2½ horse-power gasoline engine on the running-gear of a light farm wagon, and arranged it to operate a soil-auger, and with this outfit two men were able to put down as many holes in a day as thirty men could have punched with a bar and sledge. In these holes light charges of dynamite were exploded to form excavations in which to plant the trees, a number of holes being fired at a time. By this method the entire orchard was planted in less than 15 days of 9 hours each.

In a lecture recently delivered before the Derby (England) Society of Engineers, Mr. H. M. Thornton said:—"It would hardly be too sweeping a statement to say that all the requirements of our Army and Navy are under tribute to gas in some way or other. Of my own personal knowledge, I know that the enormous output of war materials we have received from our manufacturers could not have been so rapidly made without the aid of industrial gas appliances, many of which, in their present economical and effective form, are of comparatively recent introduction. It is, I venture to claim, largely due to the service of industrial gas apparatus that our new armies were in a position to take the field much earlier than could otherwise have been the case."

Perhaps the most marked feature in the history of power production has been the replacing of reciprocating machinery by that of rotary type. The steam turbine has invaded and captured a considerable portion of the fields of usefulness of the reciprocating steam engine. The centrifugal water-pump has replaced the reciprocating pump; rotary condenser auxiliaries are rapidly superseding reciprocating plant, and rotary air blowers and compressors have entered into successful contest with reciprocating compressors. The principal factors which have decided the issue in favor of the rotary plant are: small space, excellent balance, and low first cost and maintenance. In the case of the steam turbine there is the important additional advantage of using steam which otherwise would be wasted.

Chains are designated by the diameter of the rod from which the links are made, as ½ in., 1 in., etc.; also by the form of the link, as close-link, in which one link is just large

enough to inclose the two adjacent ones; open-link, in which the link is larger than in close-link; bar-chain, which consists of open links with a bar across the middle of each; twisted-link, in which each link is twisted through a certain angle, usually 90 degrees; and straight- or flat-link, which is not so twisted.

There is now recognized a special form of skin eruption due to the handling of cement. It is becoming prevalent since the extensive use of reinforced concrete. This eruption is commonly produced on the hands, fore-arm or breast when the workmen have these parts uncovered; also sometimes on the face, and the malady resembles the itch from the sensation which it produces. The effect comes from the alkaline contents of the material, and where the skin is already softened by contact with water, such substances have a marked effect. But such lesions of the skin are not serious, and a few days' rest with the use of a soothing liniment or a zinc ointment will cause the trouble to disappear. Covering the skin with a fatty substance and the use of suitable cloth gloves is a prevention, and it is recommended to give the exposed parts a good cleaning at the end of the day.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

FEBRUARY 1.

1,169,764-5-6. METHOD OF GAS-WASHING. HERMANN A. BRASSERT, Chicago, Ill.

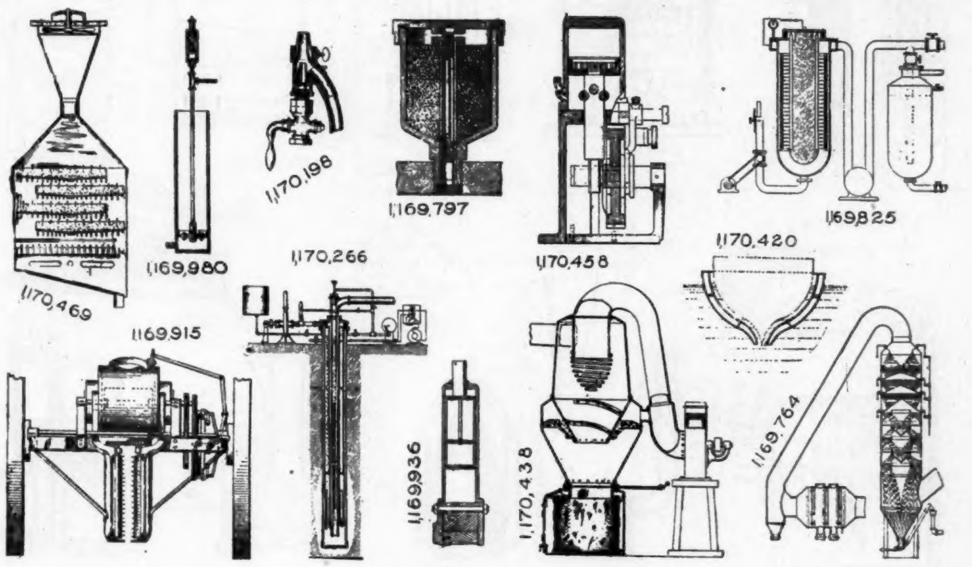
1,169,197. LUBRICATOR. HARRY R. GEER, Johnstown, Pa.

1,169,825. METHOD AND APPARATUS FOR MAKING OZONE. WILLIAM T. HOOFNAGLE, Glen Ridge, N. J.

1,169,896. VACUUM-CONTROLLING DEVICE FOR PLAYER-PIANOS. EDWIN S. WEROLIN, Brooklyn, N. Y.

1,169,915. COTTON-PICKING DEVICE. RUDOLPH F. BERAN, Moulton, Tex.

1,169,919. APPARATUS FOR DRYING GAS. HERMANN A. BRASSERT, Chicago, Ill.



PNEUMATIC PATENTS FEBRUARY 1.

1,169,936. AIR-CUSHIONED WHEEL. CHARLES I. DICKERSON, Duchesne, Utah.

1,169,980. EXHAUST-PUMP FOR MILKING-MACHINES. KENNETH K. MCLEOD, St. Paul, Minn.

1,169,995-6. METHOD OF PRODUCING ARTIFICIAL RESPIRATION. ROSCOE S. PRINDLE, New York, N. Y.

1,170,198. SAND-BLAST DEVICE. JOHN E. SWEET, ANTHONY WINTER, and FRANK G. CHAMBERS, Syracuse, N. Y.

1,170,203. AIR-PUMP FOR VACUUM-CLEANERS. THEODORE WIEDEMANN and JOSEPH H. TEMPLIN, Philadelphia, Pa.

1,170,266. APPARATUS FOR OPERATING SULFUR-WELLS. WILLIAM DANIEL HUFF, La Fayette, La.

1. An apparatus for operating sulfur mines, comprising a well casing provided with perforations near its bottom, hydrocarbon burners contained in said casing near the bottom thereof for heating the water in the well, and causing the same to melt the sulfur, a central pipe to carry off the fused products projecting down in said casing between the burners, an air tube

mounted in said pipe and provided with an air jet at its lower end, and means for supplying air under pressure to said tube, substantially as described.

1,170,420. PNEUMATIC NON-SINKABLE SHIELD FOR BOATS. CHARLES CROWLEY, Perth, Australia.

1,170,436. VENTILATOR. CHRISTIAN ERICKSON, York, N. D.

1,170,438. APPARATUS FOR SEPARATING DUST AND FOREIGN MATTER FROM AIR. CALLO D. FAHRNEY, Milwaukee, Wis.

1,170,458. AIR-PUMP FOR AUTOMOBILES AND THE LIKE. VICTOR H. PETERSON, Cambridge, Mass.

1,170,469. APPARATUS FOR DRYING AND STERILIZING AIR. REINDER PIETERS VAN CALCAR, Oegstgeest, and JAN ELLERMAN and HENDRIKUS JOHANNES MARTIJN, The Hague, Netherlands.

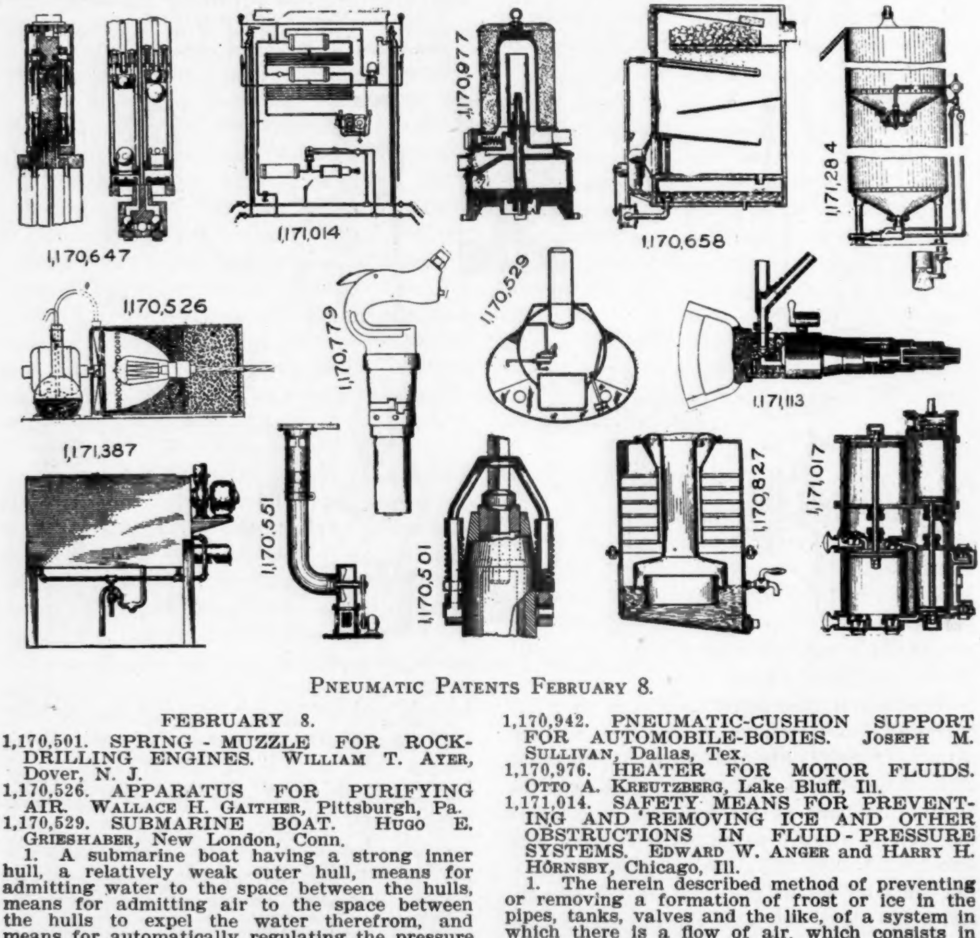
1. The combination in a pneumatic pump, a cylinder, an air outlet passage, a piston working within the cylinder and having an opening, a guide carried by the piston, a buoyant valve guided by said guide and seatable over the opening of the piston, a valve carried by the guide for closing the air outlet passage, and means for yieldingly moving the guide to seat the last mentioned valve.

1,170,658. AIR COOLING AND PURIFYING APPARATUS. JOSEPH B. MITCHELL, Detroit, Mich.

1,170,779. HANDLE-LOCKING DEVICE FOR PNEUMATIC TOOLS. REINHOLD A. NORLING, Aurora, Ill.

1,170,807. COMPRESSED - AIR - EXHAUST MUFFLER. EUGENE EGAN, Kingston, N. Y.

1,170,827. AIR-HUMIDIFIER FOR EXPLOSIVE-MOTORS. JOHN M. KROYER, Stockton, Cal.



PNEUMATIC PATENTS FEBRUARY 8.

FEBRUARY 8.

1,170,501. SPRING - MUZZLE FOR ROCK-DRILLING ENGINES. WILLIAM T. AYER, Dover, N. J.

1,170,526. APPARATUS FOR PURIFYING AIR. WALLACE H. GAITHER, Pittsburgh, Pa.

1,170,529. SUBMARINE BOAT. HUGO E. GRIESHABER, New London, Conn.

1. A submarine boat having a strong inner hull, a relatively weak outer hull, means for admitting water to the space between the hulls, means for admitting air to the space between the hulls to expel the water therefrom, and means for automatically regulating the pressure of the air admitted to the space between the hulls with reference to the pressure of the water surrounding the boat; substantially as described.

1,170,534. AIR-HOSE COUPLING FOR RAILWAY CARS. WILLIAM H. HIDLEBAUGH, Gould, Okla.

1,170,551. VENTILATING APPARATUS. JOHN M. MARTY, Cleveland, Ohio.

1,170,647. PUMP. JOHN L. LATTA, Hickory, N. C.

1,170,942. PNEUMATIC-CUSHION SUPPORT FOR AUTOMOBILE-BODIES. JOSEPH M. SULLIVAN, Dallas, Tex.

1,170,976. HEATER FOR MOTOR FLUIDS. OTTO A. KREUTZBERG, Lake Bluff, Ill.

1,171,014. SAFETY MEANS FOR PREVENTING AND REMOVING ICE AND OTHER OBSTRUCTIONS IN FLUID - PRESSURE SYSTEMS. EDWARD W. ANGER and HARRY H. HORNSBY, Chicago, Ill.

1. The herein described method of preventing or removing a formation of frost or ice in the pipes, tanks, valves and the like, of a system in which there is a flow of air, which consists in causing to be injected into the air an agent which forms with moisture or water a mixture tending to prevent the existence of ice or frost.

1,171,017. FLUID-COMPRESSOR. JOHN S. BARNER, Albany, N. Y.

1,171,113. PRESSURE - FLUID - ACTUATED TOOL. GEORGE H. GILMAN, Claremont, N. H.

1,171,286. SAND-BLAST MACHINE. HOWARD L. WADSWORTH, Cleveland, Ohio.

1,171,387. AIR - COOLING APPARATUS. GEORGE F. DICKSON, Chicago, Ill.

FEBRUARY 15.

1,171,599. TRIPLICATE VACUUM AND AIR TRAP. RUEL E. DEWEY, Grand Rapids, Mich.

1,171,669. MACHINE FOR DRESSING CHICKENS. WILLIAM SHORT, Denison, Iowa.

1. In an apparatus of the character described, an air conduit and a movable fowl carrier mounted upon the conduit and adapted to be operated to dispose a fowl carried thereby within the conduit and subject the same to a blast of air passing therethrough whereby the feathers are removed from the body of the fowl.

1,171,677. APPARATUS FOR BURNING GAS. NELSON THOMAS and ANSON W. ALLEN, Birmingham, Ala.

1. In a burner for open hearth furnaces, the combination of a pipe projecting inwardly from the rear wall of the burner, a second pipe surrounding said first pipe and providing a water space between said pipes, inlet and outlet water connections to said space, a gas connection to said inner pipe, a third small pipe located internally of said inner pipe and terminating short of the mouth thereof, means for maintaining said small pipe in axial alinement with the pipe in which it is held, means for supplying high pressure air to said small pipe and additional means for supplying air around the gas pipe, substantially as described.

1,171,695. VACUUM-AIR-LINE GOVERNOR. JOSEPH H. BRADY, Kansas City, Mo.

1,171,788. COMPRESSOR. LEONARD B. HARRIS, Haddon Heights, N. J.

1,171,926. MOTOR-DRIVEN GAS-COMPRESSOR. HENRY A. CARPENTER, Sewickley, Pa.

1,171,928. GLASS SEVERING AND PRESSING MECHANISM. GEORGE E. CLEVELAND, Fairmount, Ind.

1,171,986. WELL-PUMPING SYSTEM. WILLIAM M. STEPHENSON, Dallas, Tex.

1. A well-pumping system comprising a substantially closed receptacle mounted in the bottom portion of a well and having a valve inlet, of a discharge pipe leading from said receptacle out of the well, air supplying and air exhausting means having connection with said receptacle, and a device alternately actuated by the hydrostatic pressure of a fluid entering the receptacle during the period of its connection with the air exhausting means, and by gravity, automatically cutting off communication of the receptacle with the exhausting means, and establishing its communication with the supplying means when the receptacle is substantially full of the fluid, and automatically producing the reverse result when the receptacle is substantially empty.

1,172,001. PNEUMATIC BUMPER. EDWARD A. BAKER, SAMUEL W. JOHNSTON, and LESLIE H. JOHNSTON, Mansfield, Ohio.

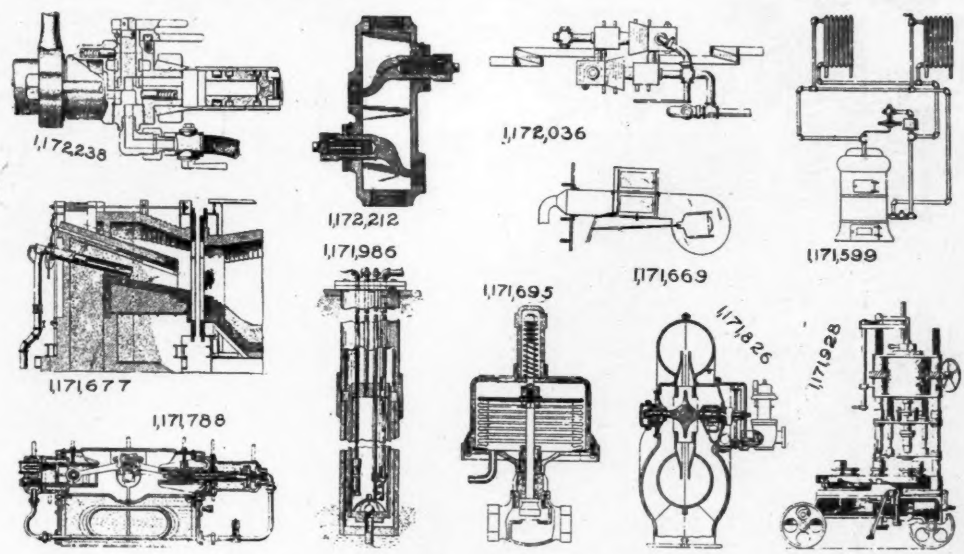
1,172,008. CONTROLLING DEVICE FOR SAND-BLAST APPARATUS. FREDERICK A. COLEMAN, Gates Mills, and DAVID S. HAWKINS and ALBERT J. FARRELL, Cleveland, Ohio.

1,172,036. AUTOMATIC AIR-COUPLING. JOHN H. NICOLSON, Birmingham, Ala.

1,172,206. AIR-HAMMER. ALONZO GRIGGS, Charleston, S. C.

1,172,212. SANDER. CHRISTIAN A. JOHNSON and HANS THISSENIUS, Laramie, Wyo.

1,172,238. PRESSURE-FED TOOL. GEORGE H. GILMAN and WILLIAM C. MICHAEL, Claremont, N. H.



PNEUMATIC PATENTS FEBRUARY 15.

FEBRUARY 22.

1,172,247-8. VACUUM-BOTTLE. CHARLES F. P. ANDERS, Hoboken, N. J.

1,172,250. PNEUMATIC ACTION. HARRY BAINTON, New York, N. Y.

1,172,279. APPARATUS FOR APPLYING AIR-BLAST TO INGOTS. ROBERT ABBOTT HADFIELD, Westminster, England.

1,172,288. FLUID-OPERABLE MECHANISM. REYNOLD JANNEY, New York, N. Y., and HARVEY D. WILLIAMS, Wallingford, Conn.

1,172,429. METHOD FOR DEHUMIDIFYING AND COOLING AIR. WILLIS H. CARRIER, Buffalo, N. Y.

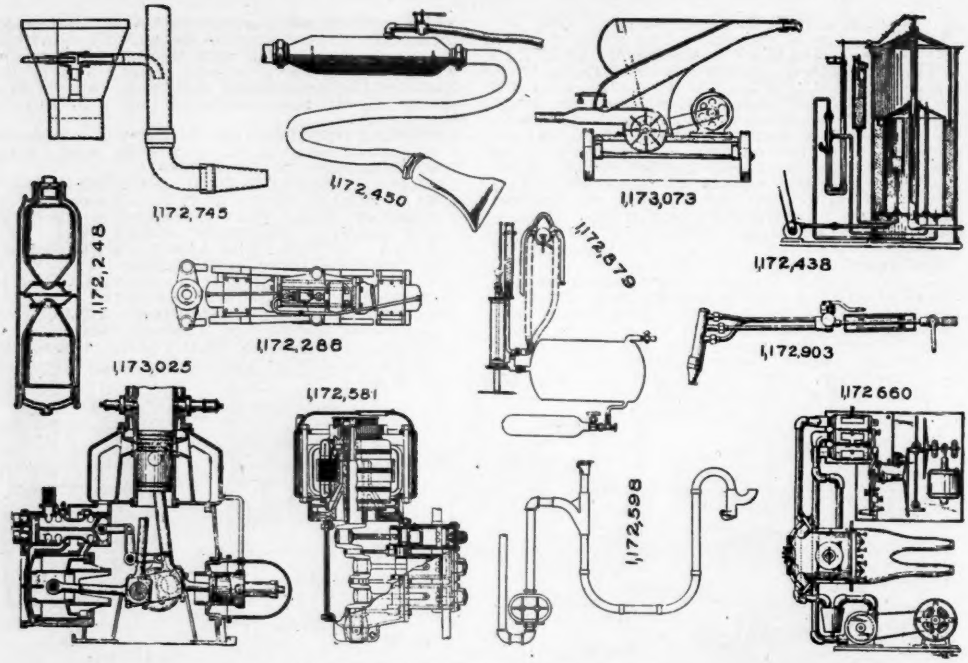
1,172,438. AUTOMATIC AIR CONTROLLING DEVICE. FRANK E. CROTTO, Dallas, Tex.

1,172,450. PNEUMATIC CLEANER. WILLIAM T. GRIFFIN, Washington, D. C.

1,172,535. GAS COMPRESSING OR CIRCULATING SYSTEM AND APPARATUS FOR USE THEREIN. ALEXANDER E. KEITH, Hinsdale, Ill.

1,172,575. DEHYDRATING APPARATUS. WILLIAM A. WOOD, Dunellen, N. J.

1,172,581. MOTOR-DRIVEN COMPRESSOR. HERBERT W. CHENEY, Milwaukee, Wis.



PNEUMATIC PATENTS FEBRUARY 22.

1,172,598. PNEUMATIC - DESPATCH - TUBE APPARATUS. JOHN S. JACQUES, Hingham, Mass.

1,172,660-1-2. SYSTEM FOR THE TREATMENT OF DISEASES OF THE HUMAN BODY BY VACUUM OR AIR-PRESSURE. CHARLES E. H. ARMBRUSTER, Denver, Colo.

1,172,716. PNEUMATIC DIAPHRAGM. JOSEPH KNAGGE, Chicago Heights, Ill.

1,172,745. APPARATUS FOR FEEDING PULVERIZED FUEL. GEORGE W. SHORT, Sharon, Pa.

1,172,879. APPARATUS FOR ADMINISTERING OXYGEN TO PERSONS IN A STATE OF COLLAPSE BY ASPHYXIATION OR OTHER CAUSES. ROBERT HENRY DAVIS, London, England.

1,172,901. FLUID-OPERATED DRILL. CAID H. PECK, Athens, Pa.

1,172,903. CUTTING-TORCH OR BLOWPIPE. MARION STUART PLUMLEY, Pittsburgh, Pa.

1,173,025. INTERNAL - COMBUSTION ENGINE AND COMPRESSOR THEREFOR. OTTO F. PERSSON, Erie, Pa.

1,173,073. PNEUMATIC CONVEYER. BENJAMIN L. WILLIAMS, Corning, Mo.

FEBRUARY 29.

1,173,156. PNEUMATIC WHEEL. FRANK W. ADDINGTON, Richmond, Ind.

1,173,178. SAND-BLAST MACHINE. JOHN L. DAWES, Pittsburgh, Pa.

1,173,247. PNEUMATIC HAMMER OR LIKE PERCUSSION-TOOL. HARRY SAMUEL BICKERTON BRINDLEY, Westminster, London, England.

1,173,250. SACK-CLEANING DEVICE. ADOLPH G. CARLSON, Chicago, Ill.

1,173,252. SECURING MEANS FOR STRIKER-PNEUMATICS. MELVILLE CLARK, Chicago, Ill.

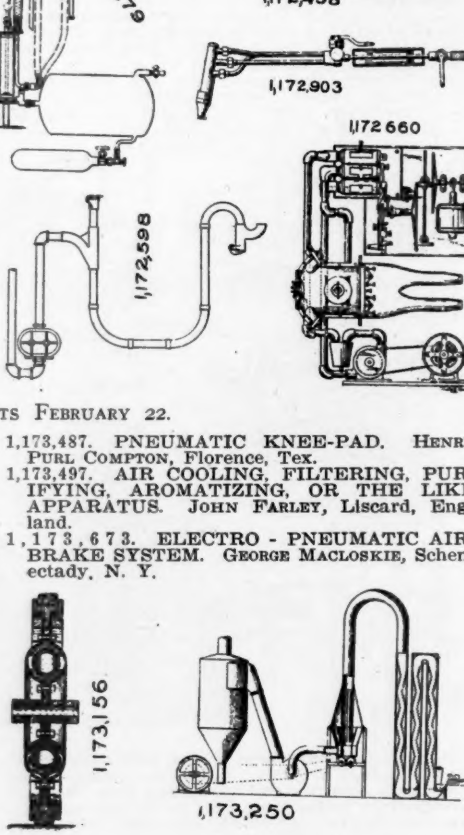
1,173,326. AIR-OPERATED TOOL. GEORGE T. TAYLOR and JOHN LESLIE TAYLOR, Sterling, Ill.

1,173,404. AIR-CHEST. JOHN T. AUSTIN and BASIL G. AUSTIN, Hartford, Conn.

1,173,487. PNEUMATIC KNEE-PAD. HENRY PURL COMPTON, Florence, Tex.

1,173,497. AIR COOLING, FILTERING, PURIFYING, AROMATIZING, OR THE LIKE APPARATUS. JOHN FARLEY, Liscard, England.

1,173,673. ELECTRO - PNEUMATIC AIR-BRAKE SYSTEM. GEORGE MACLOSKIE, Schenectady, N. Y.



PNEUMATIC PATENTS FEBRUARY 29.